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ABSTRACT

This guide to teaching photography, one in a series of instructional materials for junior high industrial arts education, is designed to assist teachers as they plan and implement new courses of study and as they make revisions and improvements in existing courses in order to integrate classroom learning with real-life experiences. This photography course is organized in 11 units, each containing objectives, vocabulary, teaching aids (such as transparency masters), suggested references, a sentence outline of the material in the unit, suggestions for materials for students, student handouts, suggested student activities, and a multiple-choice test with answer key. The units cover the following topics: introduction to photography, history of photography, camera types and designs, handling the camera, composition, exposure, film and film developing, print development, print finishing, careers in photography, and computer applications in photographic technology. Appendixes to the guide discuss cinema/movie techniques, the future of photography, and audiovisual programs. (KC)

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By

Alan L. Towler

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Foreword

This publication is one of the new series of instructional materials for industrial arts education. It has been designed to assist teachers as they plan and implement new courses of study and as they make revisions and improvements in existing courses. This publication is an attempt to help industrial arts teachers create learning environments that respond to the needs of students growing up in a complex industrial-technical society. It provides a framework that enables teachers to integrate classroom learning with real life experiences of students.

Industrial arts is being challenged to expand and clarify its function. To meet this challenge, the industrial arts curriculum must provide opportunities for students to learn more about the technological realities in our society. This publication provides teachers with an instructional platform that focuses on industrial arts' commitment to establish its content base in the technologies.

Jack E. Robertson, Ph.D.
Director, Extension Instruction
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Alan L. Towler
Industrial Arts Curriculum Specialist

Notes to the Teacher

Using the Curriculum Material

Intended Audience. The material in this curriculum package is designed for use by junior high/middle school industrial arts teachers in exploratory/introductory programs.

Length of Time for the Material. Each of the four topics of study (introduction to drafting, introduction to graphic arts, introduction to photography, and introduction to computer applications) has been developed to provide enough material for eighteen weeks of study. Individuals who teach six-, nine-, or twelve-week classes can use selected parts of this curriculum material as the substance of their classes.

Emphasis of the Material. Keep in mind that these curriculum materials are exploratory in nature. The emphasis is on exposing students to a wide range of experiences within each topic of study rather than on the development of technical expertise in one area.

Benefits for Teachers and Students. These materials are designed to assist industrial arts teachers in the classroom as they reinforce and enhance students' skills in reading, mathematics, communication, problem solving, and social interaction. In addition, teachers who use this curriculum material will be able to help their students gain an understanding of and an appreciation for management and work skills needed by indi-

viduals in the world of work. The broad exposure students receive in each topic of study will assist them in making meaningful career choices.

Flexibility of the Materials. This curriculum material, like any other material, cannot encompass all situations. Therefore, teachers should feel free to supplement this material with other ideas, information, or activities needed in their particular programs.

This material can be used in a number of different ways by industrial arts teachers. Some teachers may desire to use it as the starting point, a foundation on which to build their own courses of study. Other teachers may prefer to teach the material as it is and add to it as they feel the need. Still other teachers may pick and choose only selected parts of this curriculum for use in their classes.

Teachers may also need to make substitutions in the curriculum depending on the equipment or references available. Other circumstances may also require teachers to make curriculum substitutions. The flexibility of this material enables teachers to use it in various ways and under various conditions. This curriculum provides teachers with an alternative in course design.

Competencies. Competencies have been identified for the topic of study. As used in this material, competencies represent skills, knowledge, or attitudes that imply the ability or intelligence to accomplish a task or job. They represent the instructional intent and are stated as specific goals to be achieved. Competencies assist teachers and students in clearly formulating a purpose for learning.

Organization of the Curriculum Material

The material in each topic of study is organized into instructional units. The framework used to develop each unit consists of a number of components. These components focus on (1) outcomes, (2) materials, (3) content, (4) activities, and (5) evaluation. The components are further divided and standardized in each topic of study. An explanation of each part in the instructional unit follows.

Objectives. Objectives have been identified for each instructional unit. The objectives reflect the kind of performance necessary to successfully complete a task or job. These objectives enable a student to attain the stated competencies. Furthermore, each unit's objectives are reflected in the content, student activities, and test for that unit. Objectives help the teacher and student to focus on the important concepts to be learned in each unit. Teachers may want to duplicate the competencies and objectives and give them as handouts to the students.

Key Words: Vocabulary. New words or terms are listed to enable you to help students develop their vocabulary. Some words or terms may be listed in several units because they are used throughout a topic of study. The repetition helps reinforce vocabulary building. You will also find that each of the key words or terms has been **boldfaced** in the sentence outline. A student vocabulary worksheet has been included with each unit.

Teaching Aids. The materials, equipment, and supplies identified will enable the teacher to plan and organize instruction better. Teachers need to review this list of teaching aids before the day of instruction since some substitutions in equipment may be needed under certain conditions. A test key has been included to help the teacher in correcting the unit test.

Each transparency in the unit is also listed and briefly described. Transparency masters are provided at the end of each unit. The transparencies are keyed to a point in the sentence outline where their use is considered most appropriate. In addition to being used as transparencies, the masters may be duplicated and used as student handouts if the teacher so desires. Teachers may design or develop other transparency material that they feel enhances their instruction.

Suggested References. Many of the publications listed are available from textbook publishers. However, the reading level of these textbooks is often above junior high/middle school grade level. The materials listed in this section are suggested for use by teachers as a way to supplement their knowledge in the subject area. Teachers can review these references and use selected materials as supplements to their lectures and demonstrations when appropriate. Some of the sources suggested offer free or inexpensive materials that teachers may use with their students.

Sentence Outline. The information presented in this section represents the conceptual focus for the unit. The ideas and concepts are presented in a sentence outline, as a guide from which to teach. The outline

should serve as a reference from which teachers can provide instruction. The intent was not to needlessly duplicate material that is readily available to teachers. Rather, the intent was to provide teachers with basic ideas and information that may be less accessible. The suggested references and other resources can be used by teachers to build a knowledge base from which they can synthesize relevant concepts and information. Suggested references can be used to supplement, expand, and clarify learning activities and instruction.

Materials for Students. Suggestions to teachers regarding student materials may also be listed here. Student handout materials, such as worksheets, charts, graphs, and puzzles, are provided at the end of each unit when appropriate. These student handouts immediately follow the suggested student activities section. Handout materials may be reproduced in quantities and given to students.

Suggested Student Activities. The suggested activities are designed to reinforce and provide real applications of the concepts and content within each unit. These activities have been designed to use existing facilities and equipment as much as possible. Another consideration was the cost factor. Suggested activities are designed to require the minimum cost. Each teacher should, therefore, examine the activities and select those which are appropriate for his or her students. Teachers can change or modify the suggested activities if equipment, materials, and funds are not available. Teachers need to be selective in the activities they use since some activities take longer than others. Some are designed for group activity while others are for individual work. The teacher's content emphasis must also be considered. Each of the activities has been designed to reinforce and enhance basic skills that students need in everyday life.

Tests. Each unit has a multiple-choice test to assist teachers in evaluating student achievement. Multiple-choice tests provide certain advantages for teachers in evaluating the teaching-learning process. They do not capitalize on chance answers to the extent that true-false tests do. Careful development of test answers will help teachers evaluate a student's comprehension of important concepts. This also provides teachers with an easy way to assess the effectiveness of their instruction through item analysis.

Written tests are only one method of assessing learning. Teachers will also need to evaluate a student on actual performance in each activity, on abilities, and on general progress toward reaching objectives. Each teacher should develop an evaluation system that provides the most accurate assessment of a student's progress.

Teachers may prefer to develop their own test instruments. However, their test items should focus on the objectives and course content. The test for each instructional unit in this curriculum material does focus on the objectives stated at the beginning of each unit and on the unit content. A test key is also provided in the teaching aids section of each unit for the teacher's use in correcting tests.

Competencies

- Learn and appreciate the theory and principles of photography.
- Learn and appreciate the history of photography.
- Understand, value, and become skillful in using the various types of photographic equipment: cameras, film and paper, and accessories.
- Apply the theories, develop an appreciation for, and become skillful in the basic black-and-white film development techniques.
- Understand the principles and develop the skills related to black-and-white printing and finishing of photographs.
- Know, value, and skillfully use photo composition techniques.

1 Introduction to Photography

OBJECTIVES

After students have studied the material in this unit, they should be able to—

1. define photography;
2. identify the various types of photography and their applications; and
3. explain the purposes of photography in our society.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying photography. Teachers should help students understand these words as they are used in this topic of study.

photography	color
design	perspective
light	

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A, B, and C.
- Test Key: 1-B, 2-A, 3-D, 4-C, 5-C
- Audiovisuals:
  - Photography—How It Works, Eastman Kodak Company, Rochester, New York, 16 mm, 10 1/2 minutes.
  - Prizewinning Photos . . . What Makes Them Click? Eastman Kodak Company, Rochester, New York, slides, 17 1/2 minutes.

SUGGESTED REFERENCES

Bayer, Jonathan. Reading Photographs: Understanding the Aesthetics of Photography. New York: Pantheon Books, 1977.

Broadhead, A. Photography. New York: Time-Life Books, 1980.

Feininger, Andreas. Photographic Seeing. Englewood Cliffs, N.J.: Prentice Hall, 1978.

Hedgecoe, John. The Book of Photography. New York: Alfred A. Knopf, 1976.

Jones, Ronald F. Focus on Photography. New York: McGraw-Hill Book Company, 1981.

Tucker, Kay. The Educated Innocent Eye. Berkeley: The Image Circle, 1973.

SENTENCE OUTLINE

I. Scope of photography
   A. **Photography** is a means of recording forever the things one sees for a moment. It is better than memory because it not only recalls things to the mind, but it enables us to show with absolute realism what we have done, where we have been, what we have seen, and even what we have thought.
   B. Photography now enjoys an unprecedented popularity. Even when the excitement of the new invention from France had great impact on nineteenth-century America and the Western world, interest did not equal today's. Millions of people throughout the world pursue photography for professional or personal reasons.
   C. Photography is now serving as a means of communication, a tool for recording scientific data, and a teaching tool. It is also a form of individual self-expression.

II. Photography: definition, purposes, and characteristics
   A. Photography defined
      1. Photography literally means "writing with light." The term is generally accepted as referring to any method that produces a visible image by the action of light.
      2. The use of the term was suggested by Sir John Herschel to William Henry Fox Talbot in a letter dated February 28, 1839.
      3. Show film, Photography—How it Works, by the Eastman Kodak Company.
      4. The art of seeing
         a. In photography, seeing means realizing potentialities. This means not seeing things as they are, but visualizing them as they could be made to appear in picture form.
         b. Seeing in photography is based upon the photographer's imagination. It is, potentially, the most powerful control a photographer has to improve the impression that his or her pictures make.
         c. To successfully bridge the gap between ordinary seeing and

photographic seeing, a photographer must learn to see as the camera sees.

d. To see as a camera sees, a photographer must mute all the senses except sight.

e. A good way to learn to see a photographic subject is to analyze it in regard to its different visual qualities and to study these qualities in terms of design, light, color, and perspective.

(1) **Design** is the arrangement of a subject's components in terms of masses, light, and color.

(2) **Light** should be perceived qualitatively, rather than quantitatively. Learn to judge light by intensity, direction, type of source, and the nature of its color. The quantity of light influences the exposure of the film. The quality of light influences the mood of the picture.

(3) **Color** is a strong element, even in a black-and-white photograph. It influences the contrast of the picture. In conjunction with photographic filters, the subject's color becomes a very strong picture element.

(4) **Perspective** is the scene as viewed by the camera. The habit of seeing their surroundings always in the same "perspective" makes most people believe that only one type of perspective exists and that any other representation must be distorted. The camera presents the viewed scene in a two-dimensional perspective.

f. Practice seeing as a camera sees. Use a frame made from two L-shaped pieces of poster board. Studying a subject through a frame has several advantages:

(1) A frame takes the subject out of context.

(2) A frame makes the perspective more apparent.

(3) A frame emphasizes the design.

g. Students perform Activity A.

5. Craftsmanship

a. Craftsmanship is just as viable a part of photography as it is of any other endeavor.

b. Craftsmanship is apparent from the time of exposure of the film to the time of presentation of the finished print.

6. Communication

a. Like all the arts, photography communicates. No other recent art form has had as great an impact on so many people.

b. The photographic image of an event is the next best thing to experiencing it personally.

c. Camera images present events for contemporary society to see, and they preserve the event for historians to study.

d. Photography has served as the recorder of events in scientific laboratories as well as the medium for communicating ideas in virtually all facets of our world.

e. Photography can also serve as an art form.

B. The purpose of photography

1. The essential purpose of photography is communication. Pictures are the photographer's means of expression, as a writer's means are words.

2. As a writer must select a field of work, so a photographer must select a major field. Each field has a specific purpose:

a. **Information.** Documentary photographs, as well as most photographs found in picture magazines, newspapers, manuals, scientific publications, and pictures used for visual education, belong in this category. Their purpose is either to educate people or to enable them to make correct decisions.

b. **Slanted information.** This is the province of commercial and

advertising photography and political propaganda. The goal is to sell a product, a service, or an idea.

c. **Discovery.** Because the camera is, in many respects, superior to the eye, it can be used to make discoveries in the realm of vision. This is the field of research and scientific photography, close-up and telephotography, ultrawide-angle and high-speed photography, and abstract photographs and photograms.

d. **Recording.** Photography provides the simplest and cheapest means of preserving facts in picture form. Catalog pictures, reproductions of works of art, microfilming of documents and books, identification pictures, and certain kinds of documentary photographs fall into this category.

e. **Entertainment.** Photography provides an endless source of entertainment and pleasure. Examples are motion pictures, amateur photographs, travel pictures, and so on.

f. **Self-expression.** An increasing number of talented, creative people find in photography a relatively inexpensive means for self-expression.

3. Students perform Activity B.

4. These six categories form the main body of modern photography. For practical purposes, they can be combined into the three following groups:

a. **Reproductive-utilitarian photography.** This type of photography is used in connection with a specific profession, business, industry, or science. Its purpose is to record facts and events and preserve them for immediate or future use. The closer this sort of picture is to actuality, the greater its usefulness. The ideal example is a perfect reproduction.

b. **Documentary-illustrative photography.** Its primary function is to inform and educate. The subject and content of the picture are factual, but the form in which they are presented is artistic. Documentary photographs are intended for the general public.

c. **Creative-interpretative photography.** Its prime function is to stimulate and enrich the mind. Creative photography is concerned with the essence of things and how it is interpreted. Feelings are more important than facts, and the subject of the picture is a mood.

d. Students perform Activity C.

C. Characteristics of photography

1. **Authenticity.** Perhaps the main characteristic of any photograph is authenticity. Every photograph is an "eyewitness report." This is the quality that makes a photograph "more convincing than a thousand words" and gives it a power of conviction that is not found in any other form of communication.

2. **Speed of recording.** As a rule, only fractions of a second are needed to make the exposure, which freezes a subject or records an event in a photographic image on film. This high-speed recording is a tremendous advantage that photography has over all the other communication media.

3. **Precision of drawing and definition.** Because it is produced by precise mechanical means, every sharp photograph is an accurate reflection of reality, correct in every detail.

MATERIALS FOR STUDENTS

- Poster board
- Magazines with pictures
- Scissors
- Photograph paper

SUGGESTED STUDENT ACTIVITIES

An Introductory Activity: Printed-Out Photogram

(**Note to teacher:** This activity is suggested to introduce the course of photography.)

A "printed-out" photogram does not require a darkroom or chemicals. A kind of printed-out photogram can be seen in a suntan, which is the darkening of skin that is exposed to the sun's rays, while the unexposed part of the skin remains light.

In a photographic photogram, the pattern is caused by the action of light on a sheet of photographic paper. Photographic paper has a coating or emulsion on one side that is sensitive to light. Exposing the paper to direct sunlight for a few hours causes the emulsion side of the paper to turn dark.

To make the photogram, simply take a sheet of photographic paper and lay some objects on the emulsion (shiny) side. You can use any opaque objects, such as coins, keys, plants, pens, feathers, and so on. Since you will be out of doors in sunlight (which is brighter than an electric light), you may want to lay a sheet of glass over lightweight objects (such as feathers) to keep them in place and still. The objects should remain in place on the emulsion side for at least 50 to 60 minutes. This period of time, during which the paper faces the sun, is called the "exposure."

The completed print will show the outline of the objects. The objects will be white, and the rest of paper will turn dark after exposure to the sun. The objects have blocked the sun's rays from hitting portions of the light-sensitive paper, while the other portions have been exposed. This has caused those areas to darken. Since the image is white where light was blocked out and dark where the light struck it, it produces a reverse tone called a "negative image."

There is one major problem in making a photogram by the direct sunlight method. Unless the print is stabilized or "fixed" by using a chemical called "fixer," it will continue to be affected by light until the whole image eventually turns dark.

Photograms offer a unique way of introducing students to photography and photographic expression. Experiment with different shapes and sizes of objects. After you learn the technique for creating photograms, try using objects that are not completely opaque. These will add different tones of grays to your photograms instead of stark, black-and-white silhouettes. You may also want to try various light sources, such as flashlights, pen lights, and so on. The effects that will be achieved add another dimension to the photograms.

Materials needed:

1. photographic paper
2. objects of various shapes and sizes
3. fixer to stabilize the image
4. light source

Activity A

During the discussion of "The Art of Seeing," students will construct two "L" shapes from a piece of poster board (or students can use their hands). Students will use the L-shaped pieces to view scenes, people, and photographs as practice in seeing as a camera sees.

Activity B

During the discussion of "The Purpose of Photography," students will locate and bring to class photos illustrating the six fields of photography:

1. information
2. slanted information
3. discovery
4. recording
5. entertainment
6. self-expression

Activity C

In groups of three or four, the students will reclassify their pictures from Activity B according to the following categories:

1. reproduction-utilitarian
2. documentary-illustrative
3. creative-interpretative

Following the reclassification, have each student present several photographs and describe to the class his or her reasons for the category selection for each picture.

Activity D

Have the students view a series of color or black-and-white slides. Then the students will classify each slide according to the following groups:

1. reproductive-utilitarian
2. documentary-illustrative
3. creative-interpretative

Suggested Evaluation Criteria

Informal evaluation is made possible through observation of student participation in the recommended activities. The unit test is a more formal written form of evaluation.

Vocabulary Worksheet

1. photography

2. design

3. light

4. colcr

5. perspective

TEST

Unit 1: Introduction to Photography

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statements, and write the appropriate letter in the blank.

Example: _D_ 21. The class you are now attending is—

A. Health
B. English
C. Science
D. Industrial Arts

___ 1. Photography literally means ___.

A. seeing
B. writing with light
C. buying a camera
D. all of the above

___ 2. The use of photography was suggested by ___.

A. Sir John Herschel
B. Sir John Hedgecoe
C. Sir Marshall LaCour
D. Sir Andreas Feininger

___ 3. The essential purpose of photography is ___.

A. scientific
B. historical
C. aesthetic
D. communication

___ 4. Photography first began in the ___.

A. 1600s
B. 1700s
C. 1800s
D. 1900's

___ 5. Perhaps the main characteristic of any photograph is ___.

A. the subject matter
B. the type of camera used
C. authenticity
D. color

2 History of Photography

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. explain various important events in the history of photography;
2. identify several names of individuals who were contributors to the advancement of photography; and
3. define and explain the camera obscura.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying photography. Teachers should help students understand these words as they are used in this topic of study.

camera obscura
Polaroid
pinhole camera

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A, B, and C.
- Test Key: 1-C, 2-B, 3-C, 4-D, 5-D, 6-C, 7-D, 8-A
- Examples of the camera obscura
- Models of old cameras
- Word puzzle
- Key to word puzzle (see end of unit)
- Transparencies: You will find transparencies P2-1 and P2-2 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  P2-1: The Camera Obscura
  P2-2: The First Kodak Box Camera

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

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SENTENCE OUTLINE

I. Introduction
   A. Of all the many inventions of the nineteenth century (the electric lamp, the safety pin, dynamite, and the automobile are just a few), the invention of photography probably created the most astonishment and delight.
   B. Today, most people take photographs for granted, but early viewers were awed and amazed by the objective records the camera made.
   C. Photography gradually took over what previously had been one of the main functions of art. This was the recording of factual visual information, such as the shape of an object and its size and relationship to other objects.
   D. Photographs recorded images that the unaided eye could not see. And photography began to function as an art in its own right.
   E. This unit touches on only a few of the categories into which the history of photography can be divided.

II. Camera obscura (Transparency P2-1)
   A. The earliest forerunner of the camera, the **camera obscura**, did not look anything like a modern-day camera.
   B. Camera obscura is Latin for "dark room" or "chamber." At first, it was simply that, a dark room with a small hole in one of the walls.
   C. People sitting inside the room could

see fuzzy images from the outside form on the opposite wall. The image of the camera obscura was formed by unfocused light rays. The sharpness of the image depended on the size of the hole in the wall and the distance between the hole and the opposite wall.

D. A large hole and a long distance combined to produce a blurred image. But because a small hole meant a faint image, the camera obscura without lenses had to compromise between sharpness and brightness.

E. According to most historians, the camera obscura was equipped with lenses about the sixteenth century. This made possible the development of portable models that produced a sharper, brighter image.

(**Note to teacher:** One very simple camera can be made to simulate the principles of the "camera obscura." This is the **"pinhole camera."** Instructions on "How to Make a Pinhole Camera" and "Taking a Picture with the Pinhole Camera" are included within this unit.)

III. Famous photographers and their contributions

A. The following men have contributed greatly to the advancement of photography.

(**Note to teacher:** This is only a partial listing. You may want to use the names and activities of these men as a lesson, or you may want to use them as they relate to specific content throughout the course.)

B. Daniel Barbaro, in 1568, published and explained in detail the use of the camera obscura.

C. Johann Schultze, in 1611, discovered the use of silver salts, which darkened when exposed to sunlight.

D. Carl Scheele, in 1771, converted silver salts to metallic silver by the action of light. This laid the foundation for the modern emulsion.

E. Thomas Wedgwood, in 1802, described his process of making pictures on paper with silver nitrate.

F. Sir John Herschel, in 1839, introduced the words "photograph" and "photography."

G. Louis Daguerre and Joseph Niepce, in the 1830s, successfully used iodized silver plates. The process resulted in making a positive image directly upon a metallic silver plate.

H. William Talbot, in the 1840s, invented the first photographic negative. From his negatives, he could make any number of prints that might be required.

I. Frederick Archer, in 1851, made the first collodion wet plate. It had to be exposed immediately after being coated and developed within a few minutes.

J. George Eastman, in the 1880s, was marketing his Kodak cameras loaded with paper film (Trans. P2-2).

K. Oscar Barnack, in 1924, is credited with constructing the first 35 mm cameras.

L. Edwin Land, in 1947, produced a black-and-white print from a camera in less than a minute after clicking the shutter. The **"Polaroid"** process eliminated a problem that has always plagued photographers. This is the time delay between exposure and examination of the finished photograph.

M. The materials photographers have used have changed drastically in the short period of time that photography has existed. With new technological developments (see Appendix B), the history of photography is actually only at its beginning.

SUGGESTED STUDENT ACTIVITIES

Activity 1: How to Make a Pinhole Camera

Materials:

- Oatmeal box, shoe box or coffee can, or 35 mm film container or box
- Electrical tape
- Aluminum foil
- Pin
- Flat black paint
- Photographic paper

The first thing you need to make a pinhole camera is a box that can be made lighttight so that no stray rays of light will enter and fog the film or photographic paper. Boxes that can be used for this purpose are shoe boxes, oatmeal boxes, coffee cans, or any other similar box that has a tight-fitting lid and holds a four-inch by five-inch sheet of photographic paper. Next, you need to make

the pinhole, which will serve as the lens on the camera. Take a smooth piece of aluminum foil that is about an inch square. Lay it on a flat, hard surface, such as metal or glass. The hole should be perfectly round and free from ridges. The foil should not be pushed out where the pinhole was made. The hole itself will be hard to measure, but it should be too small for the entire pin to fit through.

After you have selected the box, paint the inside of it flat black. If the inside remains a light color, it will reflect or bounce the light passing through the pinhole in all directions and fog your paper. Next, make a hole in the center of one side of the box. Tape the aluminum foil with the pinhole securely over the larger hole. Use an opaque tape, such as black electrical tape. Make sure that the pinhole is in the center, and then take another piece of opaque tape and cover the pinhole. This piece of tape will act as the camera shutter.

Loading the pinhole camera with photo paper must be done in darkroom conditions using a safelight. Use an unexposed, fresh sheet of photo paper, like that used in making photograms. Center it on the side opposite the pinhole. Make sure that the emulsion side is facing the hole. After this is done, tape the four corners down so that the paper won't move around inside the box. Replace the lid on the box, and you are ready to take a picture.

Activity 2: Taking a Picture With a Pinhole Camera

To take a picture, or expose the paper, place the pinhole camera on a firm support—something that will not move. Tape or put a weight on the camera so that it does not move accidently during the exposure. This is important, because any movement during the exposure will cause your picture to be blurry and out of focus. After your camera has been securely fastened to the support, open the tape that is covering the pinhole. Expose the picture for two minutes if it is a sunny day and for eight minutes if it is cloudy and overcast. Make sure that, when you open and close the shutter, you do not move the camera.

The camera will need to be taken back into the darkroom, where the photo paper may be taken out and processed. The resulting image will be a negative. If your negative is too light, then increase your exposure time. Just remember that the brighter it is outside, the shorter the exposure time. The cloudier it is outside, the longer your exposure time will be.

You will probably want to make several exposures with your pinhole camera. Keep a record of the length of your exposures and the lighting conditions. This will enable you to determine the best exposure time for that specific lighting situation. The procedure of varying your exposure time (two minutes, three minutes, four minutes, and so forth) is called "bracketing."

Activity 3: Experiments

If a room is available that has the criteria for making a camera obscura, have the students plan and conduct some experiments.

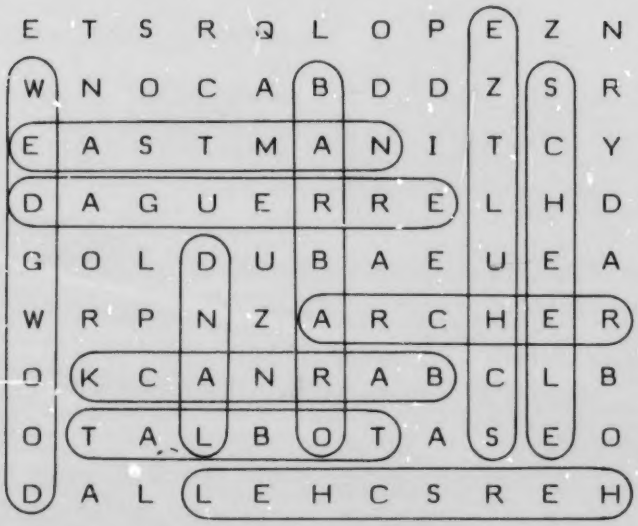
1. Select a room or closet with a window.
2. Darken the room with paper or other material.
3. Experiment with different sizes of openings.
4. Experiment at different times during the day, and determine which position of the sun makes the best image.
5. Experiment with various positions of the wall or opposite wall. You may want to use a movable chalkboard or partition.

Note: This activity could be conducted with an art class. In addition to simply projecting the image, have students trace it on paper.

Special Considerations

The main consideration in selecting a subject is movement. Most people can't sit or stand still for two or more minutes. When they move, this creates a blurry image on the paper. It is best to shoot unmoving objects, such as buildings, landscapes, and stationary objects.

Word Puzzle Answer Key



1. LAND
2. BARNACK
3. EASTMAN
4. ARCHER
5. TALBOT
6. DAGUERRE
7. HERSCHEL
8. WEDGWOOD
9. SCHEELE
10. SCHULTZE
11. BARBARO

Word Puzzle

Directions: The names below are located in the puzzle. These names may be spelled across, down, diagonally, and backwards. When you locate the names, circle them.

E T S R Q L O P E Z N
W N O C A B D D Z S R
E A S T M A N I T C Y
D A G U E R R E L H D
G O L D U B A E U E A
W R P N Z A R C H E R
O K C A N R A B C L B
O T A L B O T A S E O
D A L L E H C S R E H

1. LAND
2. BARNACK
3. EASTMAN
4. ARCHER
5. TALBOT
6. DAGUERRE
7. HERSCHEL
8. WEDGWOOD
9. SCHEELE
10. SCHULTZE
11. BARBARO

Vocabulary Worksheet

1. camera obscura

2. Polaroid

3. pinhole camera

TEST

Unit 2: History of Photography

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. The discovery of photography gradually took over what had been one of the main functions of art, which is—

A. the recording of all information
B. the recording of factual information
C. the recording of factual visual information
D. none of the above

___ 2. The term "camera obscura" is Latin for—

A. camera
B. dark room or chamber
C. obscure camera
D. hole in the wall

___ 3. One of the earliest detailed explanations of the use of the camera obscura was explained by—

A. Schultze
B. Scheele
C. Barbaro
D. Land

___ 4. The words "photograph" and "photography" were introduced by—

A. Scheele
B. Wedgwood
C. Talbot
D. Herschel

___ 5. The first photographic negative was invented by—

A. Archer
B. Kodak
C. Daguerre
D. Talbot

___ 6. Kodak cameras were designed by—

A. Land
B. Kodak
C. Eastman
D. Barnack

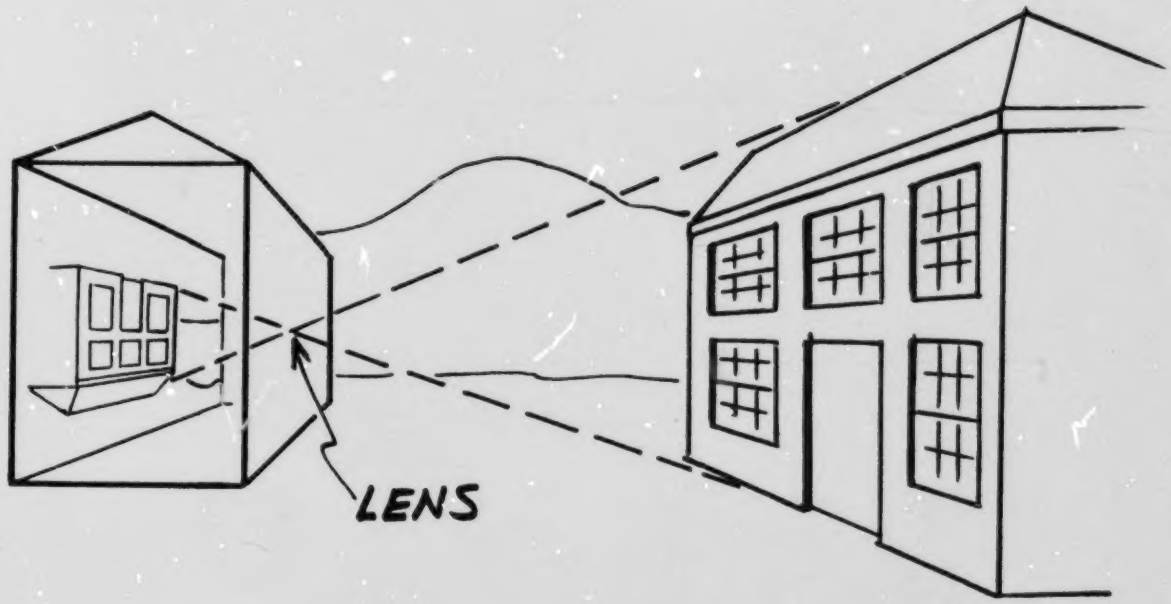
___ 7. The first 35 mm camera was designed by—

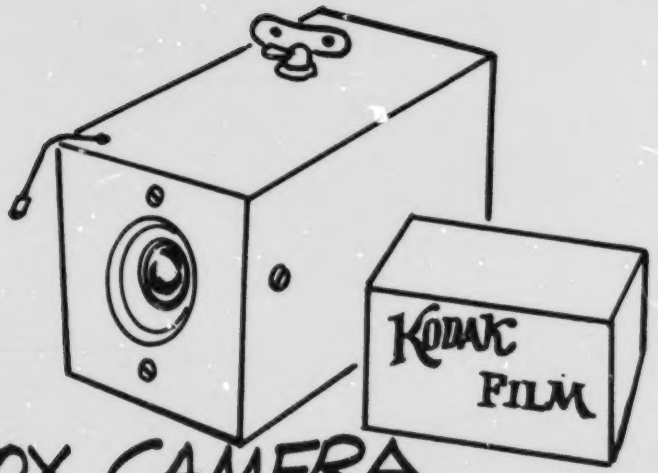
A. Land
B. Kodak
C. Eastman
D. Barnack

___ 8. The "Polaroid process" was produced by—

A. Land
B. Kodak
C. Eastman
D. Barnack

THE CAMERA OBSCURA





THE FIRST
KODAK BOX CAMERA

GEORGE
EASTMAN

3 Camera Types and Designs

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. identify and describe the basic camera types;
2. identify and describe the basic camera design characteristics;
3. identify and describe the various types of lenses; and
4. identify and describe the various controls on a camera.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying photography. Teachers should help students understand these words as they are used in this topic of study.

aperture	diaphragm
lens	shutter
viewfinder camera	parallax
single-lens reflex (SLR)	twin-lens reflex (TLR)
view camera	shutter speed
f-stop	wide-angle lens
normal lens	telephoto lens
format	

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A, B, and C.
- Test Key: 1-B, 2-B, 3-B, 4-B, 5-C, 6-C, 7-A, 8-D, 9-D, 10-A, 11-A, 12-B, 13-B, 14-A, 15-B
- Transparencies: You will find transparencies P3-1A through P3-7 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

P3-1A: Essential Parts of a Camera
P3-1B: Eye-Camera Comparison
P3-2: Viewfinder or Rangefinder Camera
P3-3: Single-Lens Reflex Camera
P3-4: Twin-Lens Reflex Camera
P3-5: View Camera
P3-6A: Lenses Can Range From . . .
P3-6B: How a Filter Controls Light and Color
P3-7: Camera Controls

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Jones, Ronald E. Focus on Photography. New York: McGraw-Hill Book Company, 1981.

Neblette, C. B. Photographic Lenses. Dobbs Ferry, N.Y.: Morgan and Morgan, 1975.

Slides, Kodak Program Series 35: An Introduction. Eastman Kodak Company, Rochester, N.Y., 22 1/2 minutes.

Slides, Effective Use of Lenses. Eastman Kodak Company, Rochester, N.Y., 21 1/2 minutes.

Slide/tape, Imaginative Use of Filters. Eastman Kodak Company, Rochester, N.Y., 22 1/2 minutes.

SENTENCE OUTLINE

I. The camera (Transparency P3-1A and P3-1B)
   A. All cameras are basically alike.
   B. Each is simply a box with a piece of film in one end and a hole in the other.
   C. The hole is there so that light can enter the box, strike the chemically sensitized surface of the film, and make a picture.
   D. Every camera from the inexpensive Brownie-type camera to the sophisticated model costing thousands of dollars works in the same way.
   E. The differences are in how well and easily each camera does the job. The job is always the same—getting light onto the film to form an image.
   F. To do the job properly, certain things are needed (see Transparency P3-1A).
   G. To begin with, there must be a viewing system, a sighting device that enables the user to aim the camera accurately at the subject.
   H. The hole that admits light to the camera, the **aperture,** must be made adjustable by a device called a **diaphragm** to control the amount of light entering. There must be a **lens** to

collect the light and project the image onto the film.

I. There must be a movable screen, the **shutter**, to keep all light out of the camera until the moment arrives for taking a picture.

J. Then a button is pressed, the shutter opens for an instant, just long enough to admit enough light to make a satisfactory image on the film (Trans. P3-1B).

K. There must be a device for moving the exposed film out of the way and replacing it with an unexposed piece.

L. Finally, there should be a focusing mechanism to move the lens back and forth so that it can project sharp images of objects that are both near and far away.

M. All cameras except the very cheapest have all these features in some form. If that is so, then why are there so many different kinds of cameras?

N. The reason is that cameras are asked to do so many different things, under such a wide variety of conditions, that they have had to become specialized.

O. A bulky studio camera has features that make it ideal for making portraits indoors. But for unposed pictures of children at a picnic, it is not as good as a pocket-size camera.

II. Four major camera types

A. **Viewfinder camera** (Trans. P3-2)

1. Viewfinder cameras use a small lens, often set behind a rectangular window, through which the subject area can be seen.
2. The lens slightly enlarges the view, but there is one disadvantage. The area seen through the viewfinder differs slightly from the area seen by the lens, in the same way that one eye has a slightly different view from the other. This fault in certain viewfinder cameras (mainly early types), known as **parallax** error, was later corrected by the introduction of the coupled rangefinder, a distance-measuring device for focusing.
3. Parallax can also be compensated for by composing the picture within framing lines marked on the viewfinder lens.
4. This viewing system has been applied to cameras of all sizes, ranging from subminiature to technical. In larger-format cameras, the viewfinder often supplements the ground-glass screen system.
5. **Advantages:** In its cruder forms, it is inexpensive and has fewer moving parts that could break down. In the more sophisticated rangefinder models, it provides excellent focusing, particularly at low light levels. Some other viewing systems do not function as well in these conditions.
6. **Disadvantages:** A simple viewfinder has an inherent defect called parallax error that prevents it from seeing exactly what the lens sees. Unless parallax error is automatically compensated for (as in high-quality cameras, such as Leica), the viewfinder camera is almost useless for carefully composed, close-up work, such as portraits or pictures of flowers. Also, images seen through the average viewfinder are sometimes small and difficult to focus.

B. The **single-lens reflex** (Trans. P3-3)

1. The single-lens reflex (SLR) receives the image, through the camera lens, onto an angled, movable mirror, which transfers the image to a glass screen. The image is identical to the one received by the film, so there is no parallax error.
2. A spring mechanism links the mirror to a focal plane shutter release. When the shutter is tripped, the mirror automatically snaps out of the path of exposure.
3. The small viewing screen of the 35 mm camera has lately been improved by adding a magnifying pentaprism viewer for eye-level viewing of the upright image.
4. The principal components of the single-lens reflex are the viewing system and the focal plane shutter.
5. The main difference between most models lies in the lens

flange design. This can have a screw thread, breech block, or bayonet.

6. Flange-to-film distance also varies.
7. Integral light meters and automatic diaphragms and focusing devices are becoming commonplace with many manufacturers.
8. Some have interchangeable film magazines and provide for instant picture packs, while some sophisticated 35 mm models have motorized film-winding mechanisms.
9. **Advantages:** The SLR eliminates parallax. It is easily and quickly focused, which makes it good for candid photography. Since the viewing system uses the camera lens itself, it obviously works equally well with all lenses. Whatever the lens sees, the photographer sees. This is unlike the viewfinder camera, which cannot vary the focusing scene to suit the picture-taking lens.
10. **Disadvantages:** The (SLR) is heavier and less compact than the viewfinder. However, a popular trend with modern camera manufacturers is to create smaller, more compact SLR cameras. The SLR is also more complex and hence more liable to break down. Because it has a moving mirror, it is noisy. It makes a loud click when a picture is taken, compared with the almost inaudible click of a good rangefinder camera. Also, the light must travel through lenses, off a mirror, then through a viewing screen and a prism to get to the user's eye. Therefore, finding the critical point of focus under poor lighting conditions is often difficult.

C. The **twin-lens reflex** (Trans. P3-4)

1. The twin-lens reflex, popularly called the TLR, employs two lenses. These are both mounted on a movable panel, one above the other.
2. The top lens carries the viewing image upright and laterally reversed, on a ground-glass screen. The bottom lens incorporates a diaphragm and shutter and carries the image onto the film.
3. Both lenses have the same focal length. Focusing is usually done with a knob on one side of the camera body that moves the lens panel backward or forward.
4. A folding metal hood shades the viewing screen and holds a retractable magnifier for fine focusing.
5. **The great advantage of the twin-lens reflex design is its combination of compactness and a generous viewfinder.**
6. Introduced in the late nineteenth century, the camera is easy to operate and uses roll film with a 2 1/2-inch square negative format of the same dimensions as the ground-glass screen. (**Note:** Format refers to the size of the negative.)
7. This means that the camera can be held vertically for viewing, regardless of the shape of the subject or image.
8. Negatives make fairly large contact prints, and pictures can be cropped in the enlarger.
9. The main disadvantage of the TLR is its lack of interchangeable lenses, and a need for a more flexible lens system offering a range of lenses, bodies, backs, and viewfinders.
10. The standard TLR cameras have a rapid-action lever for winding on film. They also provide for eye-level focusing through a pentaprism, while some have built-in exposure meters.
11. **Advantages:** The fixed mirror means simple, rugged construction and quiet operation. The viewing screen permits convenient, accurate composition on a flat plane. Because the photographer looks into this camera from the top, he or she can lower it to waist level or even place it on the ground for photographing babies, pets, and so forth. This is an awkward angle for an eye-level viewfinder.

12. **Disadvantages:** The principal problem is parallax error, although the best twin-lens reflexes have automatic parallax corrections. Another drawback, which takes getting used to, is that the image projected onto the viewing screen is reversed from side to side. The larger-size twin-lens reflex, while permitting larger film, makes the camera somewhat more cumbersome for candid work. On most twin-lens reflexes, lenses are not interchangeable.

D. The **view camera** (Trans. P3-5)

1. The view camera is designed mainly for professional photography. Though the camera size requires large-format sheet film and a tripod on a monorail mounting, it is extremely flexible. For example, the front and back panels can be made to shift, rise and fall, and tilt and swing. Therefore, an infinite number of corrections to the image are possible.
2. A ground-glass screen receives the image, and focusing is done by means of bellows.
3. A wide variety of lenses of different focal lengths are made. Each are panel-mounted and have an integral shutter and diaphragm.
4. The image is focused on the screen by leaving the shutter open with the aperture at its widest f-stop.
5. To avoid disturbing the fine focusing, you can rigidly secure the panels and keep the bellows from sliding by tightening knurled knobs.
6. After closing and tensioning the shutter, the aperture is set and replaced by the film holder.
7. Film holders are double-sided, each side having a thin panel that shields the film.
8. This panel is removed when the holder is in place, so that the exposure can be made, and then returned to the holder after the exposure.
9. Sheet film, plates, roll film, and instant print film can be used.
10. **Advantages:** The image on the viewing screen is projected directly there by the picture-taking lens. Thus, what the photographer sees is exactly what will be on his negative. There can be no parallax error. Furthermore, the viewing screen is very large, permitting detailed examination by magnifying glass to check the sharpness of focus in all parts of the picture. The film size is also large, giving sharp detail in large pictures. The camera itself is adjustable, permitting the photographer to tilt and twist it to correct focus problems or distortion.
11. **Disadvantages:** The most serious disadvantage is the bulkiness of the camera. You must use a tripod. Second, the image projected on the viewing screen is not very bright, and the photographer, to see it better, must put a cloth over the head and the back of the camera. Finally, the image appears reversed and upside down on the viewing screen. Photographers get used to this, but it is disconcerting at first.

III. Lenses (Trans. P3-6A)

A. Focal length

1. Photographic lenses are of three basic types: normal focal length, wide-angle, and long-focus. The description of a particular focal length is dictated by the format (negative size) of a camera.
2. In **normal lens**, the focal length is approximately equal to the diagonal measurement of the camera format.
3. For example, the diagonal of a 2 1/4-inch square negative (as used in twin-lens camera) is about 80 mm. Anything less than 80 mm is, for this size of negative, a wide-angle lens. Anything in excess of it is a long lens.
4. As the format changes, say to 35 mm, an 80 mm lens is considered a long lens, and the "normal" focal length would be 50-55 mm (the diagonal of the negative size).

5. A second factor in this relationship between normal, wide-angle, and long-focus is the **angle of view** of the lens.
6. A true **wide-angle lens**, used with whichever format, would be expected to have an angle of view exceeding 70°, whereas a normal lens has an angle of view between 45°-55°. A long-focus varies, but rarely exceeds 35°.

B. **Wide-angle lens**
1. A wide-angle lens usually has a small maximum aperture compared with the other two lenses.
2. It tends to distort cylindrical objects at the edges of the field. So take care when using a wide-angle lens for portraiture, unless distortion is the effect you want.
3. Use a short focal-length lens to become closely involved with the subject.
4. A large depth of field is almost inevitable, especially with small negative formats (for example, 35 mm) because of the short focal lengths involved.
5. Obviously, the wide-angle lens is ideal when such a large subject area must be included and the shooting conditions, in terms of physical space, are limited.
6. But it can be used with equal success in a large landscape, adding mass to foreground and breadth to the whole scene.

C. The fish-eye lens
1. The fish-eye is an extreme wide-angle lens that reproduces the center of the picture on the scale expected from the quoted focal length, but distorts the image shape more and more as the scale diminishes toward the edges.
2. A photograph taken with a fish-eye lens resembles a reflection in a globe.
3. With the exception of the center lines, all horizontal and vertical lines are curved.
4. The result is a highly distorted image.

D. Long-focus lens
1. At the opposite end of the scale, the long-focus lens offers observation from a distance and close-up detail without close involvement with the subject.
2. It is used extensively by the press for portraiture and in wildlife and sports photography.
3. Its limited angle of view demands distant viewpoints and is inclined to flatten perspective.
4. Long-focus lenses have a comparatively limited depth of field.

E. The **telephoto lens.** This is a particular type of long-focus lens that uses two groups of lens elements. These elements enable the lens designer to achieve long focal lengths without extreme lens-to-focal plane distance.

F. The normal lens
1. The normal (or standard) lens supplied with most camera systems is a compromise between the two extremes.
2. It is convenient for most subjects, but convenience seldom produces the most interesting photographs. This lens should be used with care, particularly with regard to framing.
3. It is sometimes useful to have a normal lens that is slightly longer than the diagonal of the camera format, for example, an 80 mm lens on a 35 mm camera instead of a 55 mm lens.
4. This helps to avoid the "general view" type of photograph by making more of a close-up with the framing.

IV. Filters and light (Trans. P3-6B)

A. Although all panchromatic films are sensitive to every color in the spectrum, they are more sensitive to certain colors. Because of this, filters are used to lighten or darken objects of a particular color.

A filter is usually a colored piece of glass that is placed in front of the lens. Usually, it screws into the diameter of the lens. Like any filter, it absorbs what is not wanted and passes or transmits what is wanted. Understanding filters requires some knowledge of the behavior of light. Light is radiant energy that travels in waves. In visible light, the longest wave is

red, the middle length is green, and the shortest is violet. With those wave-length groups are the various hues of red, orange, yellow, green, and blue. If there are not waves, then there is no light. When all the waves travel together, the result is white light.

In a way, any object we see as having color is acting like a filter, because it is absorbing parts of the white light surrounding it. The color we see is part of the light that is reflected back to us. For example, a red apple seems to be red because it absorbs blue and green light and reflects red light. Yellow paper looks yellow because it absorbs blue light and reflects both green and red. The following table lists certain colors as they appear in white light and the colors of light that are absorbed.

Understanding filters is quite easy once you understand the principle that they always subtract some of the light from a scene. Remember that you are dealing with negative-positive relationships. When a filter absorbs a color, that area of color will appear to be lighter in the negative. However, when the negative is printed, that color will appear darker.

Filters that are used for black-and-white pictures can be classified into three groups: (a) correction filters, (b) contrast filters, and (c) haze filters. Although panchromatic film is sensitive to all the colors of the spectrum, it is not sensitive to all of them equally. For instance, blue sky generally prints out to be very light in tone. To compensate, use a correction filter which changes the tonal response of the film so that all colors are photographed at about the same brightness values as originally seen by the eye. The most popular correction filter is a medium yellow (K-2). A photograph, taken with a yellow filter, reproduces the clouds as they were seen in their relative brightness values. They appear "bolder" because the blue sky appears darker. The yellow filter absorbs some blue light, thereby making the blue appear darker in the print.

A contrast filter can either increase or decrease (lighten or darken) the contrast between colors. To make an object appear lighter than it is, use a filter that is the same color as the object. To make an object appear darker than it really is, use a filter that will absorb the color of the object. Keep in mind that a filter transmits its own color, making that color lighter. To make a color darker, use a filter that will absorb that color. Refer to the chart to help you select an appropriate filter.

Contrast filters are also used to darken the sky. The medium-yellow (K-2) filter is used to reproduce the sky as your eye would see it if you saw things in black and white instead of in color. The deep yellow (G) filter will make the sky seem even darker than it normally appears. For even more dramatic effects, a medium red (A, or No. 25) filter can be used. A deep red filter (No. 29, or F) will make the sky almost black.

When you photograph landscapes in the distance or from high altitudes, the picture tends to lose a certain amount of detail. This is caused by the bluish atmospheric haze that is

Color Seen in White Light	Color of Light Absorbed
red	blue-green
green	red and blue
blue	red and green
yellow (red plus green)	blue
magenta (red-blue)	green
cyan (blue-green)	red
black	red, green, and blue
white	none
gray	equal portions of red, green, and blue

caused by very small particles of dust and water vapor. The haze scatters ultraviolet light to which film is very sensitive, although the eye cannot see it. To reduce atmospheric haze when photographing, you can use haze filters to filter out some of the ultraviolet light. The amount of haze is decreased with the following filters: K-2, G, A, and F.

One filter that can be used to eliminate both haze and reflections or glare is the polarizing filter. As light is reflected from nonmetallic surfaces, it is polarized. This means that the light vibrates in only one direction. The light from the sky is polarized because it is reflected from nonmetallic particles in the atmosphere. The polarized filter removes glare by stopping the path of the polarized light.

The angle of the light source is important when using a polarizing filter. To get the maximum effect from such a filter, the angle at which you view the reflecting light must be equal to the angle at which the light strikes the reflecting surface. For instance, if the sun were at an approximate 60° angle from a scene, you would get maximum effect with the polarizing filter if you took the picture at a 60° angle.

Most polarizing filters are double-threaded. One thread screws into the camera, while the other one lets you rotate the filter. If the camera you are using is not a single-lens reflex or view camera, place the filter to your eye and rotate it until the desired effect is obtained. Note that a marking on the filter, usually a white dot, is used to indicate the position of the rotation. After the desired effect is produced, place the filter on the camera, making sure that the marking is in the same position. If you have a single-lens reflex camera, you can see the effect by looking through the viewfinder while you rotate the screen.

The polarizing filter is useful when photographing water, glass, or most other shiny surfaces. The reflections are eliminated, allowing more detail to be seen.

B. Filter factors

Because filters absorb some light, you must increase the exposure to compensate. The number by which you multiply the exposure is called the filter factor. If a filter has a factor of 2, you must either double your exposure time by decreasing your shutter speed by one speed or open the lens one stop. For example, a yellow filter has a factor of 2. If the proper reading without the filter were 1/250 at f/8, then with the filter, it would be either 1/125 at f/8 or 1/250 at f/5.6. Generally, it is best to change the f-number rather than the shutter speed.

Filter factors depend on the type of light and the film being used. The deep yellow (G) filter has a daylight factor of 2.5 with Kodak Plus-X film. However, when you use artificial light (tungsten), like that from photofloods, the factor is 1.5. The reason for this is that sunlight contains more ultraviolet and blue light than photofloods give out. Therefore, in outdoor sunlight, the deep yellow filter absorbs a greater portion of the light, and additional exposure is needed to compensate for this loss.

If your camera has a through-the-lens metering system, you do not have to worry about filter factors. This type of meter reads the light after it has already passed through the filter. The exposure reading is therefore based on the reduced amount of light.

V. Major camera controls (Trans. P3-7)

The three major controls on a camera lens system are (1) the shutter speed setting; (2) the f-stop, which indicates the size of the diaphragm aperture; and (3) the distance scale, which assists in focusing.

A. Shutter speed settings are usually located on the camera body, sometimes on the lens mount. Normally, aperture and focusing controls are in the form of rings set into the barrel of the lens.

B. Exposure is a product of the amount of light allowed to fall on the film (controlled by aperture) and the duration that light is allowed to act on the film (as controlled by speed setting).

C. To keep exposure constant, any change in the size of the aperture must be

matched by a change in speed, and vice versa.

D. Most speed settings are marked in seconds in the progression: 1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60, 1/125, 1/500.

E. Each setting is thus about twice as fast as the previous one.

F. Marked aperture settings follow the accepted series: f/1, f/1.4, f/2, f/2.8, f/4, f/5.6, f/8, f/11, f/16, f/22, f/32, f/45, f/64.

G. The series represents a strict geometrical progression. So for each increase in f-number, the area of the aperture, and hence the amount of light passing through it, is cut in half. (If the maximum opening of a given lens is not included in this series—for example, f/1.8 or f/3.5—the series nevertheless continues normally after beginning with the odd number.

H. The two scales of aperture and speed are therefore directly related. In changing the aperture by one setting (one stop), the amount of light falling on the film is halved or doubled. The time the light is allowed to act is similarly altered by the speed setting.

I. The distance scale permits the lens to be focused on the correct point to form a sharp image.

J. This scale begins at approximately 18 inches and continues in steps to infinity, marked with the symbol ∞. On either side of the focus index mark, most cameras have a series of numbers that correspond to the aperture scale, either on the camera body or on the lens.

K. This scale gives an indication of depth of field at a given aperture and distance setting.

SUGGESTED STUDENT ACTIVITIES

Activity 1

Materials: As many types of cameras as possible should be obtained and set up on tripods. These can also be passed around or set up on tables. Items of interest for student observation could include:

A. camera format size
   1. subminiature (110 size)
   2. 35 mm
   3. 2 1/4" x 2 1/4"
   4. 4" x 5" or larger, if possible
   5. disc camera

B. other camera features
   1. single-lens reflex
   2. twin-lens reflex
   3. rangefinder focusing
   4. ground-glass focusing

Procedures: With cameras aimed at various subjects or targets, have the students focus the cameras on the subjects. Viewfinders and focusing systems should be pointed out to the students.

Note: The teachers should be very much aware of any student who appears to have problems focusing the cameras. Vision correction problems may be identified at this time.

Activity 2 (see table on following page)

Using the table, have the students, in groups of two, assign the various camera qualities in the list on the left that should be considered in the selected shooting situations shown in the list on the right. Camera qualities may be applied to more than one shooting situation. Class discussion should follow the completion of the activity for the purpose of comparison and clarification of ideas.

Activity 3

Have students conduct a picture-taking assignment using the various cameras, lenses, and filters.

Activity 4

Use cameras without film, and practice aiming and focusing.

Activity 5

Draw and diagram the parts of a camera (including the mirror system).

Activity 6

Identify the parts of the camera shown on the handout entitled "Camera Controls."

Camera Qualities	Shooting Situations
1. smallness 2. medium film or camera size 3. large film or camera size 4. lens speed 5. lens interchangeability 6. wide-angle lens 7. telephoto lens 8. shutter speed 9. parallax 10. perspective control 11. speed of operation 12. noise level 13. sharpness of rendition 14. sequence shooting 15. size and weight	1. advertising 2. animal (domestic) 3. animal (wildlife) 4. architecture 5. children and babies 6. close-up 7. copy work 8. general 9. industrial 10. interiors 11. landscapes 12. nature (general) 13. news, documentary 14. objects, work or art 15. people (general) 16. portraiture 17. sports 18. theatre and stage 19. travel

Vocabulary Worksheet

1. aperture

2. diaphragm

3. lens

4. shutter

5. viewfinder (rangefinder) camera

6. parallax

7. single-lens reflex (SLR) camera

8. twin-lens reflex (TLR) camera

9. view camera

10. shutter speed

11. f-stop

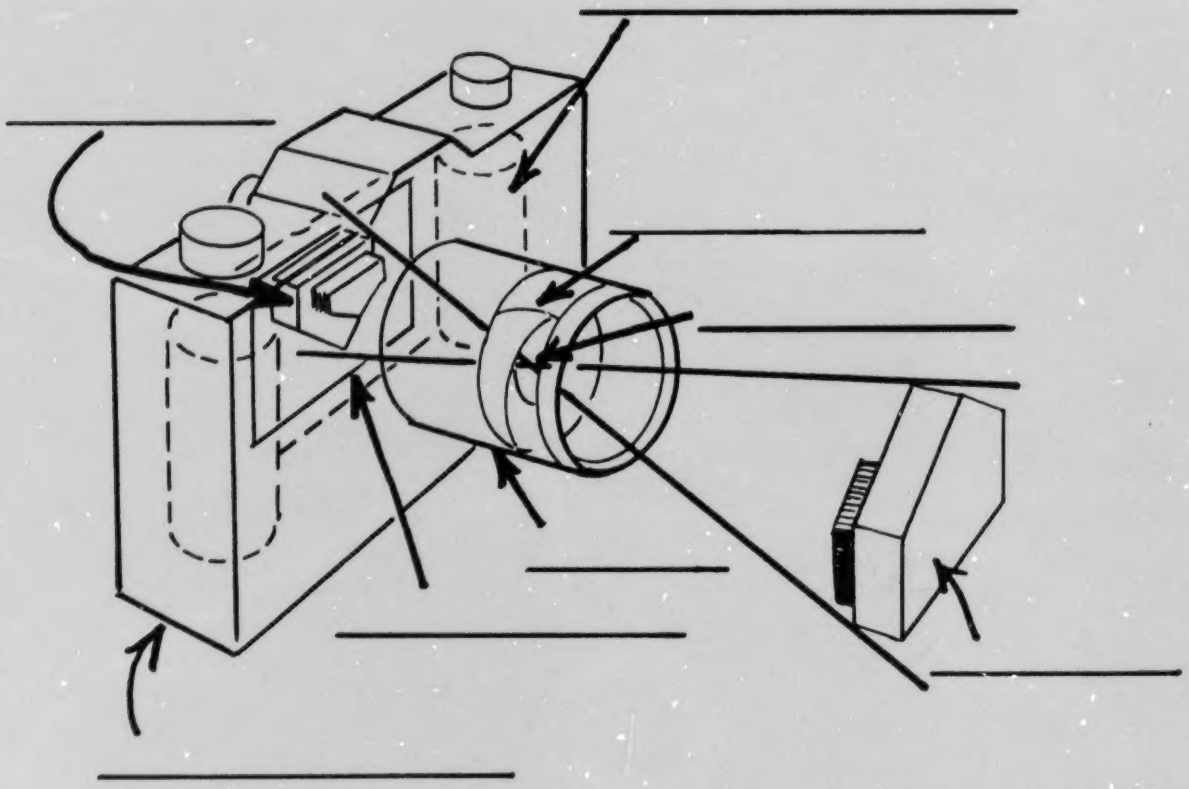
12. wide-angle lens

13. normal lens

14. telephoto lens

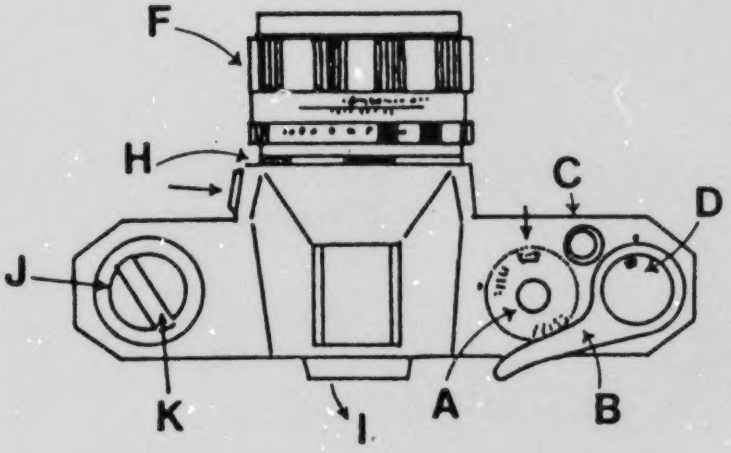
15. format

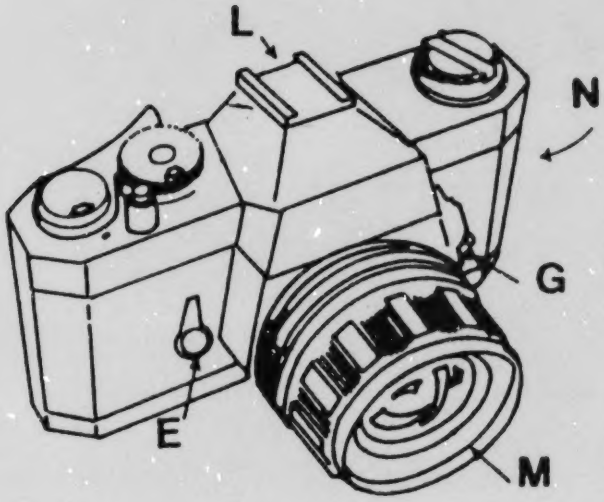
IDENTIFY ESSENTIAL PARTS OF A CAMERA



CAMERA CONTROLS

IDENTIFY PARTS OF THE CAMERA





A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

N. _____

TEST

Unit 3: Camera Types and Designs

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: _C_ 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. All cameras have the following, except—

A. a sighting device
B. timer
C. a shutter
D. a lighttight body

___ 2. The hole that admits light to the camera is—

A. the shutter
B. the aperture
C. the lens
D. the exposure

___ 3. Parallax does not exist in the —

A. viewfinder camera
B. single-lens reflex camera
C. twin-lens reflex camera
D. rangefinder camera

___ 4. The single-lens reflex camera is also called a—

A. twin-lens camera
B. 35 mm camera
C. studio camera
D. view camera

___ 5. The twin-lens reflex camera is good to use because of its—

A. parallax error
B. use of two lenses
C. compactness and generous viewfinder
D. lack of interchangeable lenses

___ 6. The view camera is designed mainly for—

A. amateurs
B. beginners
C. professionals
D. novices

___ 7. View cameras use—

A. sheet film
B. 126 film
C. 35 mm film
D. 2 ¼ film

___ 8. The most serious disadvantage of the view camera is—

A. the small size
B. parallax
C. the cost of the camera
D. the bulkiness of the camera

___ 9. Exposure is—

A. the amount of light allowed to fall on the film
B. the duration that light is allowed to act on the film
C. the change in the size of the aperture
D. A and B

___ 10. The f-setting controls—

A. the aperture
B. the shutter speed
C. the exposure
D. all of the above

___ 11. A normal lens is—

A. one with the focal length equal to the diagonal measurement of the camera format
B. 8 mm to 35 mm
C. 100 mm to 500 mm
D. all of the above

___ 12. A fish-eye lens is considered a—

A. normal lens
B. wide-angle lens
C. telephoto lens
D. long-focus lens

___ 13. Filters are used on cameras and placed—

A. in between the lens and the camera
B. on the front of the lens
C. in front of the film
D. in back of the film

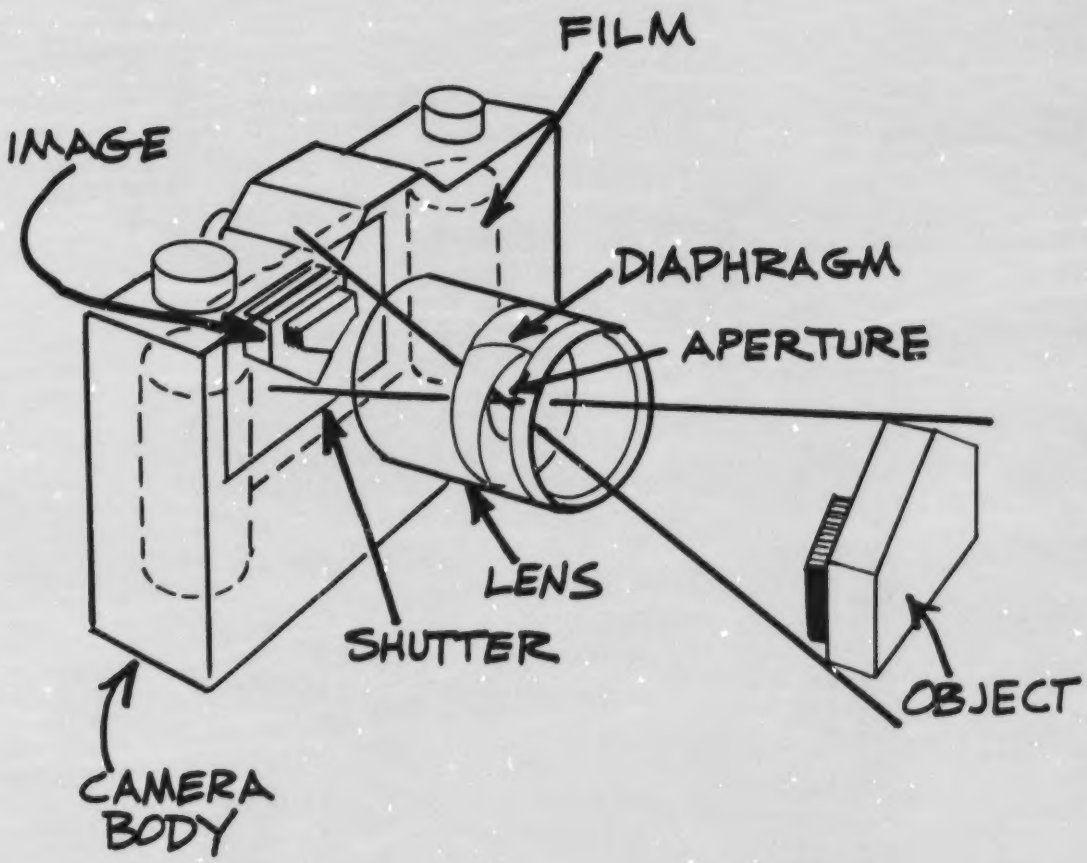
___ 14. One filter that can be used to eliminate both haze and reflection or glaze is—

A. the polarizing filter
B. the yellow filter
C. the green filter
D. the red filter

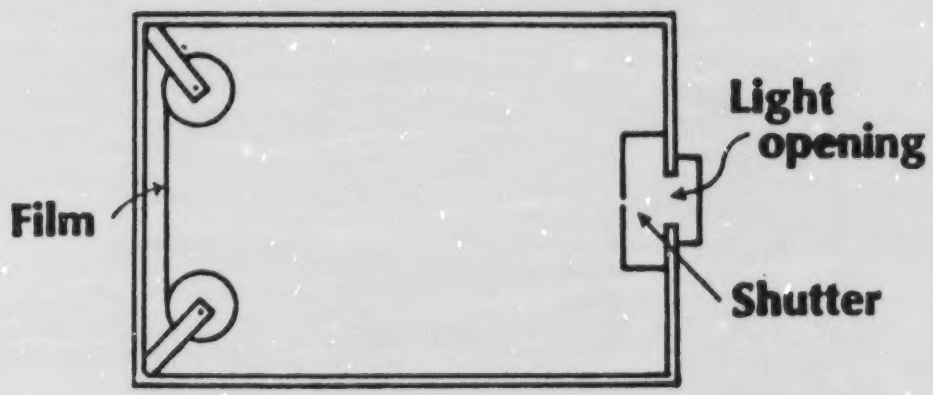
___ 15. Filters—

A. allow more light to enter the camera
B. allow less light to enter the camera
C. allow the same amount of light to enter the camera
D. none of the above

ESSENTIAL PARTS OF A CAMERA

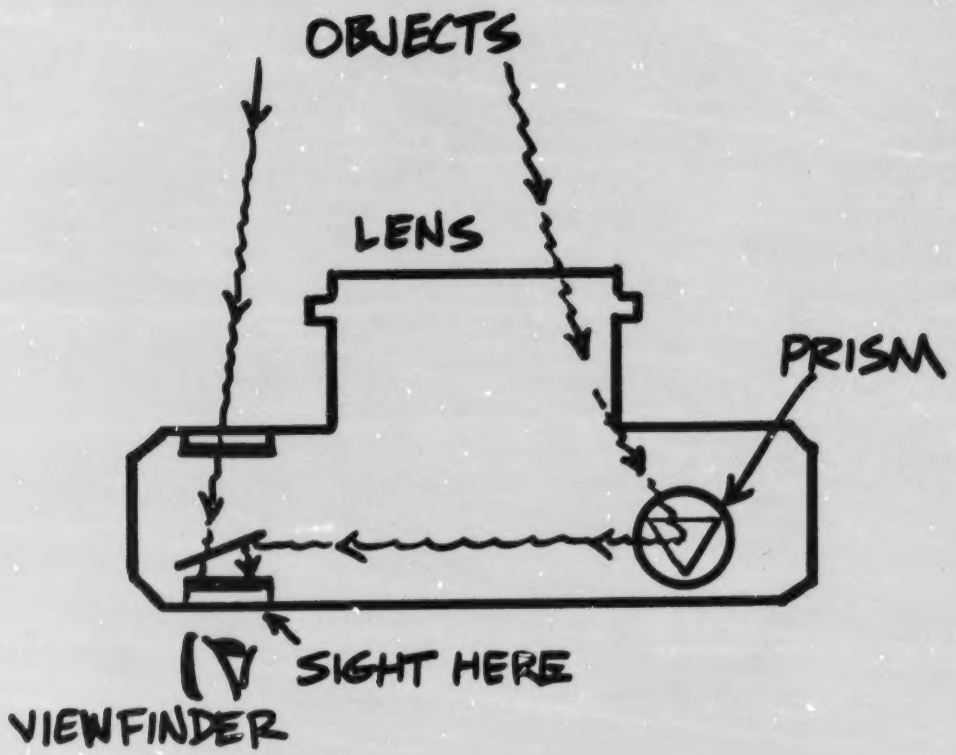


EYE-CAMERA COMPARISON

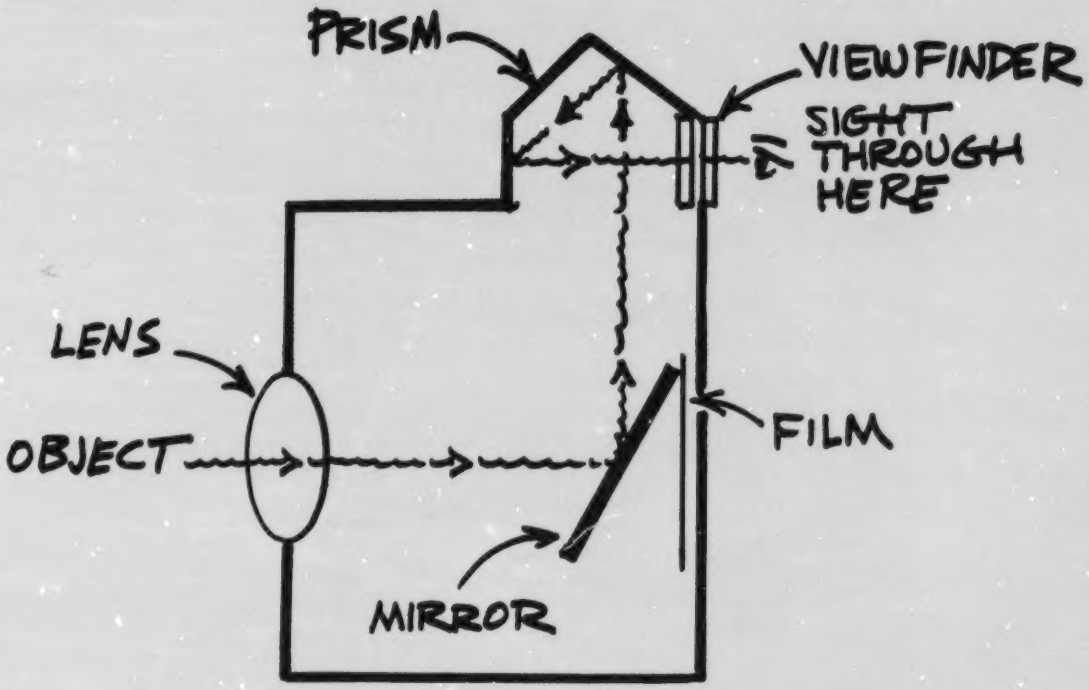


Lighttight box

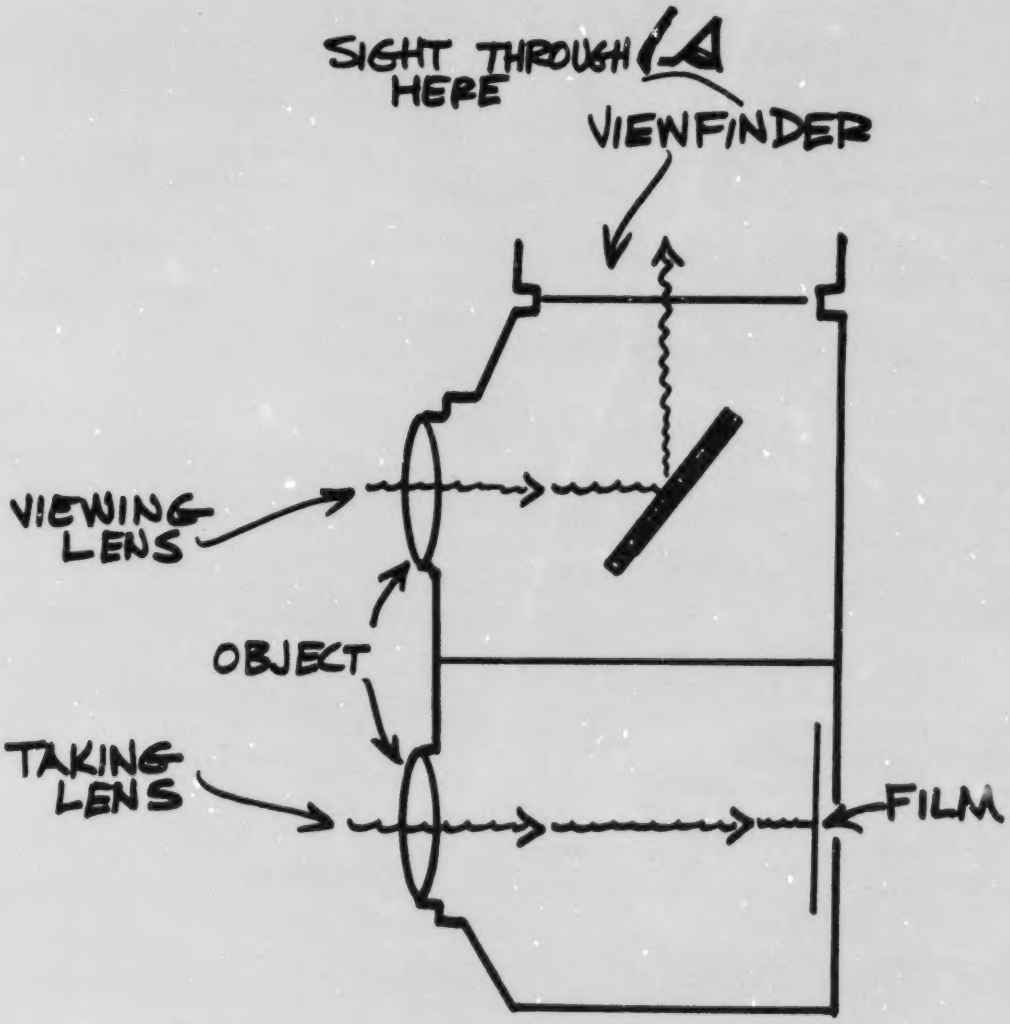
VIEWFINDER OR RANGEFINDER CAMERA



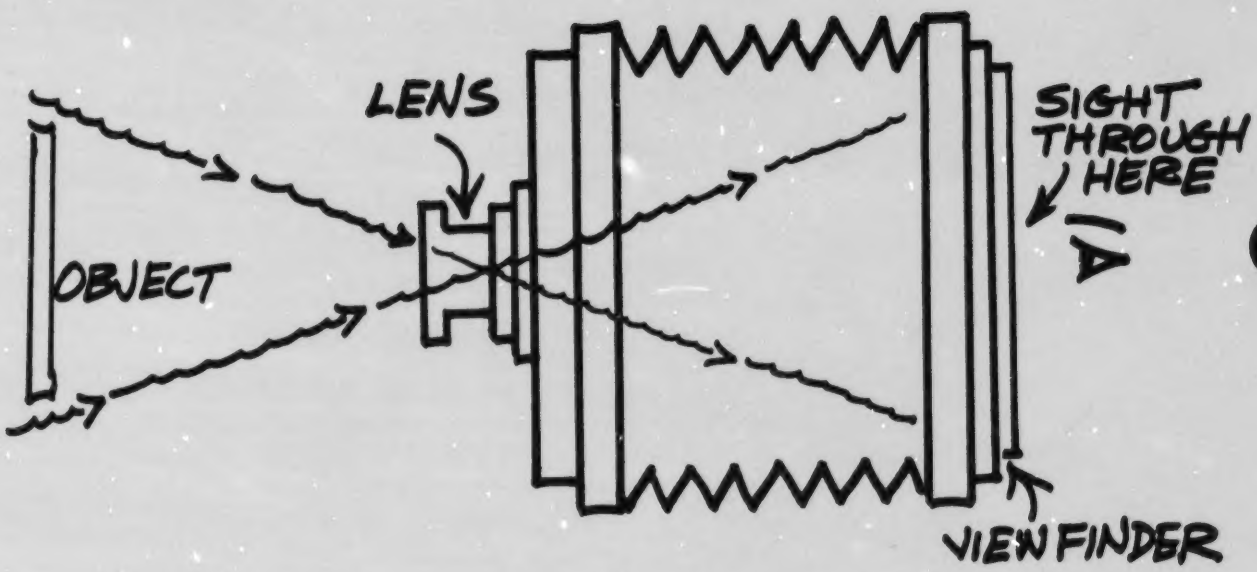
SINGLE-LENS REFLEX CAMERA



TWIN-LENS REFLEX CAMERA

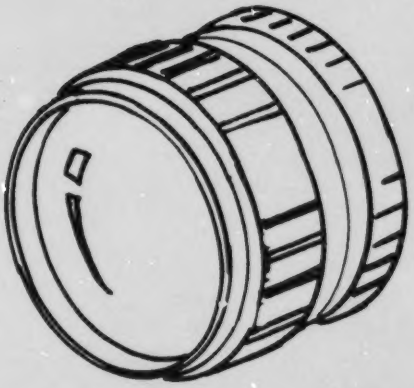


VIEW CAMERA



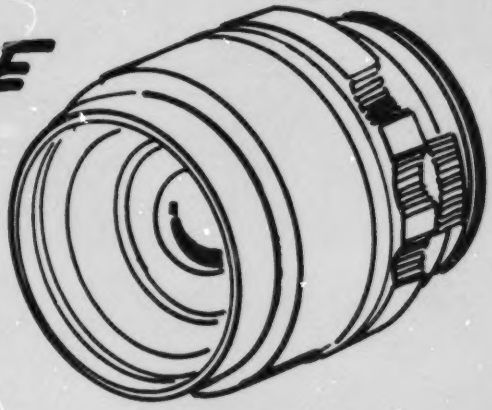
LENSES CAN RANGE FROM...

NORMAL



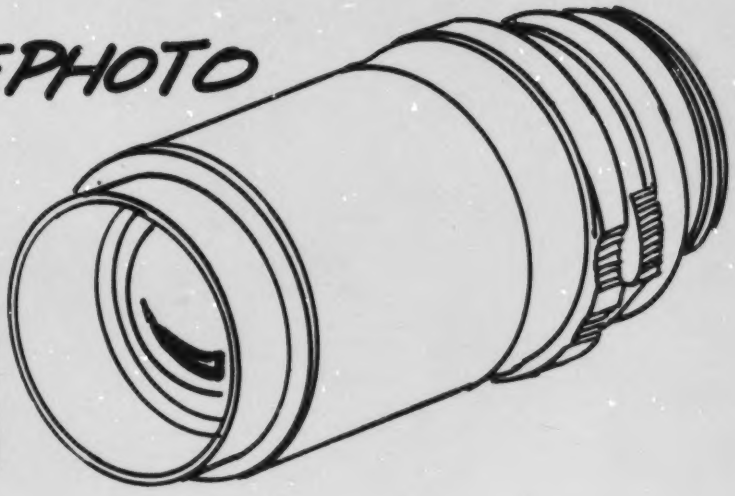
...TO...

WIDE-ANGLE

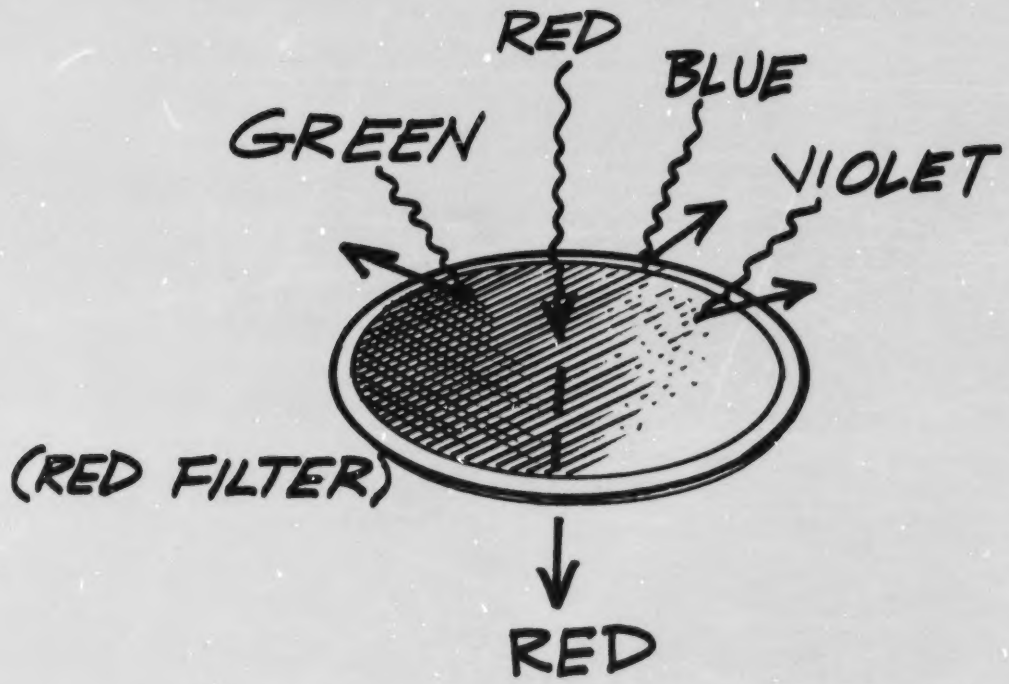


...TO...

TELEPHOTO

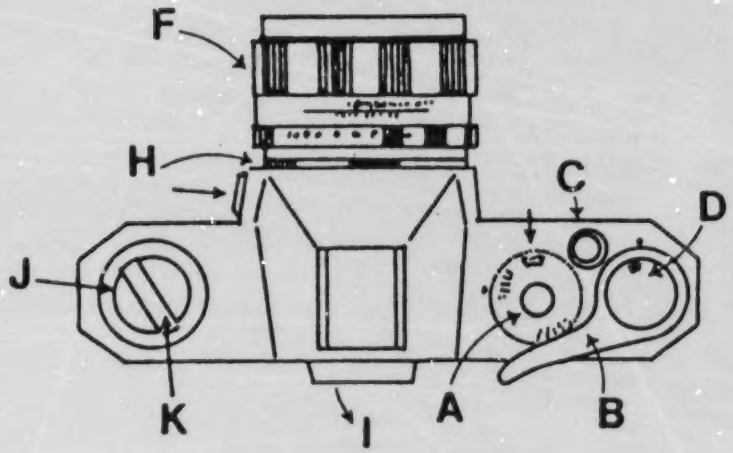


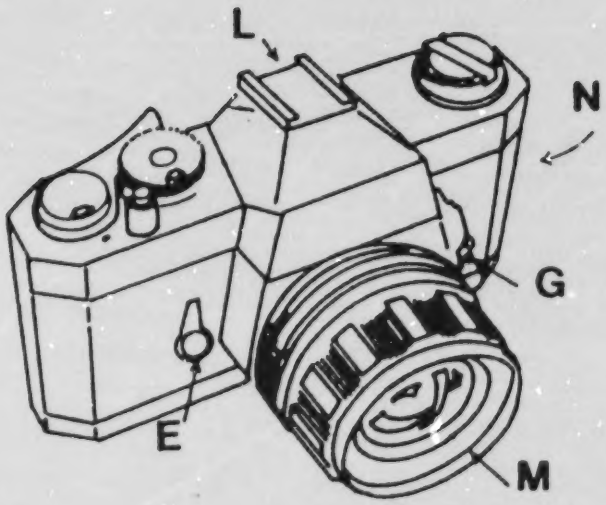
HOW A FILTER CONTROLS LIGHT AND COLOR



CAMERA CONTROLS

PARTS OF THE CAMERA





A. SHUTTER SPEED DIAL

B. ADVANCE LEVER

C. SHUTTER RELEASE

D. AUTOMATIC RESET EXPOSURE COUNTER

E. SELF-TIMER COCKING LEVER

F. FOCUSING RING

G. FLASH TERMINAL

H. PREVIEW LEVER

I. VIEWFINDER

J. REWIND KNOB

K. REWIND CRANK

L. HOT SHOE

M. LENS

N. BODY

4 Handling the Camera

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. identify good camera storage practices;
2. demonstrate proper methods of carrying the camera;
3. properly clean camera lenses;
4. load, advance film, and unload film from a camera;
5. demonstrate proper methods of holding the camera during exposure; and
6. demonstrate how to properly change lenses.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying photography. Teachers should help students understand these words as they are used in this topic of study.

roll film
camel's hair brush
lens cleaner
Instamatic
lens cleaning tissue
interchangeable
sprockets

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A, B, and C.
- Test Key: 1-D, 2-C, 3-A, 4-D, 5-C, 6-B, 7-B, 8-C
- Transparencies: You will find transparencies P4-1 through P4-3 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  P4-1: Loading the Camera
  P4-2: Carrying the Camera
  P4-3: Holding the Camera

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Adams, Ansel. The Camera. Boston: New York Graphic Society, 1980.

Reynolds, Clyde. Focalquide to Cameras. New York: Hastings House, 1977.

Slides, Basic Picture-Taking Techniques. Eastman Kodak Company, Rochester, N.Y., 15 minutes.

Sussman, Aaron. The Amateur Photographers' Handbook. New York: Thomas Y. Crowell Company, 1973.

Upton, John and Barbara. Photography. Boston: Little, Brown & Company, 1981.

SENTENCE OUTLINE

I. Introduction
Photographic film is a cornerstone of photography. However, unless this light-sensitive material is loaded correctly into the camera, photography becomes an exercise in futility. There is only one way to load film into your camera, **the right way.**

II. Loading the film (Transparency P4-1)

A. The easiest type of film to load is the cartridge used in Instamatic-type cameras. Simply drop the cartridge in a position so that it lies flat inside the camera back. Since the cartridge will fit in only one way, loading it upside down is impossible for most people. Close the back of the camera firmly until it locks, and advance the film by moving the winding mechanism until it stops. This usually takes about one and a half turns of the lever or knob. On the back of the camera is a window that shows you how many pictures you have taken. Since cartridge loading is simple, there are only two things to remember. First, turn the advance lever or knob after each picture until it stops. (Don't force it.) Second, after the last picture has been made on the roll, advance the film until no more paper can be seen in the window.

Roll film is a term for film that is rolled onto a spool rather than enclosed in a magazine (as is 35 mm film or 120 mm film) or in a cartridge (as is Instamatic film). Like cartridge film, roll film has an opaque paper backing. Loading it into the camera requires that the full spool be inserted into an empty chamber in the back of the camera. After the spool is firmly in position, draw out some of the tapered

paper leader and insert that tapered end into the take-up spool. Make sure that the tapered end is caught in the slot, or else the film will not be pulled through the camera. Close the back of the camera and turn the advance lever until the window shows the number 1. This is the usual method in roll film cameras. However, some cameras are equipped with automatic stopping devices. This makes watching the window for each consecutive exposure unnecessary. Check your camera manual to be sure.

B. Another method of film loading is used for 35 mm film, which comes in a magazine in lengths of either 20 or 36 exposures. There is no paper backing on 35 mm films. This means that (1) after all the pictures have been taken, the film must be rewound back into the magazine or cassette; and (2) there is no window on a 35 mm camera to show how many pictures you have taken. Instead, there is a film counter that is numbered from 0 to 36.

Loading 35 mm film into the camera requires six steps. First, open the back cover of the camera. In some cameras, this is done by pulling up on the rewind knob until the lock is released on the back. Other 35 mm cameras have a separate latch that must be released before the back will open.

Second, insert the film cartridge, or cassette, into the specially designed chamber. With most 35 mm cameras, it is necessary to lift up on the rewind knob to do this. After the cassette is secure in the chamber, push the rewind knob back down. This action will prevent the cassette from moving around inside the camera.

Third, draw out some of the tapered film leader from the cassette and insert it into the slot of the film take-up spool. Make sure that the film leader is placed so that the bottom edge is resting evenly on the edge of the take-up spool. After checking this, advance the film by using the advance lever, making sure the film perforations have engaged the sprockets on both sides. Don't worry about losing pictures because the back is open. Film manufacturers always supply extra film in the cartridges for this situation. (Some photographers may brag that they can take 39 pictures on a 36-exposure roll. But what they don't mention are how many rolls they have ruined by trying to squeeze in those extra exposures.)

After you have made sure that the **sprockets** of the take-up spools are sticking through the perforations of the film, close the back of the camera until it locks. Then, after the back is closed, turn the rewind crank slowly in a clockwise direction until you feel the tension. Don't force the crank, because this can rip the perforations of the film. The purpose is to take up any slack in the film. Since a 36-exposure roll is almost five feet long, there will usually be some slack. Advance the film by turning the lever. Depress the shutter release button and advance again until the number 1 appears in the exposure counter window. While you are advancing the film, watch the rewind knob. It should rotate counterclockwise, indicating that the film is advancing through the camera properly.

When the entire roll of film has been exposed, you must rewind the film back into the cassette before opening the camera. Locate the rewind button on the camera so that the film can be rewound without ripping the perforations. After the button has been depressed, turn the rewind crank clockwise until you feel the tension release. Open the back of the camera and remove the film cassette.

One word of advice: After you have taken 20 pictures on a 20-exposure roll or 36 on a 36-exposure roll, rewind the film back into the cassette. Don't try to sneak another picture on the roll. You may win out, but you may rip the end of your film to shreds. It just doesn't pay.

III. Storing the camera

A. Clean the camera and lens prior to storage. Be sure to use a good lens cleaning fluid and lens tissue only.

B. If the camera is to be stored for an extended period of time, remove the

battery if the camera has one.

C. The camera's shutter should be released prior to storage. This removes tension from the shutter spring mechanism.

D. Store the camera in its case, if available.

E. Four conditions that are the chief enemies of the camera are shown in the following list. These conditions should be avoided when storing the camera as well as when the camera is in use:

1. careless handling
2. dust
3. moisture
4. heat (as inside a car)

IV. Carrying the camera (Trans. P4-2)

A. Hold the camera by its body whenever possible.

B. Inspect the neck straps and/or wrist straps on a regular basis.

C. Never carry a camera "swinging from its strap."

D. Do not carry a camera "over the shoulder." Carry it with the strap either around your neck or your neck and shoulder.

E. Use a lens cap when you are not actively engaged in picture taking.

F. If a lens cap is not on the camera, adjust the camera focus to the nearest setting when you are not actively taking pictures.

G. Protect the camera from moisture, dust, and heat.

H. If the camera is equipped with **interchangeable** lenses, make certain the lens you use is secure in its mount.

V. Lens cleaning and protection

A. A lens is a precision instrument. Much skill and care have been exercised in producing it. It must be kept in the best condition if it is to perform properly.

B. A few suggestions and warnings should be carefully followed in its care:

1. If the movable parts of a lens do not work smoothly and easily, do not force them.
2. Impact is very dangerous to a lens, so avoid allowing it to fall or bang into something solid.
3. The cement used to assemble the glass elements of a lens is very sensitive to heat. Avoid extremes of heat.
4. **Lens cleaning.** It is necessary to clean the front and back surfaces of the lens occasionally. Great care should be taken so that the lens surface is not scratched. To remove dust or grit, gently brush the surface with a soft **camel's hair brush.** If a camel's hair brush is not available, use a piece of **lens cleaning tissue** (which should always be available), wadded to form a brush and used as such. If this does not clean the lens, wipe it very gently with a wad of lens cleaning tissue using a circular motion. Occasionally, fingerprints or scum formation on the lens cannot be removed by these procedures. In these cases, never wash the lens with water, alcohol, acid, or other harsh solvent. Use one or two drops of a reliable **lens cleaner** on a wad of lens cleaning tissue. (**Note:** Do not apply lens cleaner directly to the lens. Use only lens cleaning tissue—do not use facial tissue.) Do not allow fingerprints to remain on the lens.

VI. Loading, unloading, and advancing the film

A. Always try to load and unload your camera in **subdued light,** even if the best you can do is to turn your back to the sun.

B. Always check the instructions that accompany the film. Some films require total darkness for loading and unloading.

C. Ensure that the film is properly attached to the take-up spool and is snug in the camera prior to closing the camera.

D. Be sure to advance the film the required distance before attempting to start shooting.

E. Make sure you know the film speed prior to closing the camera after loading the film.

F. When advancing the film, do not exert force if an unaccountable resistance is met.

G. Most 35 mm cameras require the exposed film to be rewound into the original cassette prior to removing it from the camera. Do not forget to rewind **before** you open the camera.

H. When using an exceptionally long shutter speed in fast shooting situations, you may find yourself attempting to advance the film prior to completing the exposure. Not only will this ruin the shot, it will seriously damage the camera's shutter mechanism.

I. All new cameras, and many used ones as well, come equipped with an instruction booklet. Remember, "When all else fails, follow the instructions."

VII. Holding the camera (Trans. P4-3)

A. The basic rule in holding a camera is to "hold the camera steady." It is next to impossible to obtain a sharp, crisp image on the film if the camera is in motion. Using a fast shutter speed is helpful in obtaining sharp images, but it may have to be sacrificed due to other considerations.

B. Use a relatively fast shutter speed.

C. Gently squeeze the shutter release button rather than pushing it with a great deal of force or with a jerky motion.

D. When forced to use a shutter speed slower than 1/60 second, either place the camera on a tripod or brace it against something solid.

E. When using a camera with a waist-level viewfinder, try holding the camera so that the neck strap is taut around your neck.

F. When necessary, sit down and use your elbows on your legs as a tripod.

G. Try holding your breath at the instant of releasing the shutter. But don't hold it very long or you'll begin to shake.

H. For very long exposures, try using the cable release or the time delay if the shutter speed is one second or faster.

VIII. Changing lenses

A. The idea of being able to change lenses on a camera may be new to many students. For this reason, the following statement is helpful. Make sure the camera you are attempting to change lenses on does in fact use interchangeable lenses. Not all cameras have interchangeable lenses. One brand name camera may not accept lenses manufactured by another company. You may be required to use an adapter in order to make the two match.

B. The main thing to remember when changing lenses on a camera is that you must protect the interior of the camera body from all foreign matter while the lens is removed. This also means that you should not touch anything inside the camera while the lens is removed.

MATERIALS FOR STUDENTS

- Camera
- Cartridge or roll film

SUGGESTED STUDENT ACTIVITIES

1. How to Use Your Camera

Objective. Each student should learn how to use the camera that is available for him or her to use.

Materials. Each student should bring to school whatever camera is available at home.

Procedure

(1) The instructor will show each student how to load film into the camera.

(2) Students will also learn the function of the parts of the camera used and will experiment with focusing, setting apertures, correct f-stop settings, and so forth.

Principle. Students should learn how to operate the camera from observing the instructor during the demonstration. To successfully take pictures, the students must know the purpose of each part of the camera.

2. Loading Film (Use this activity after students have handled their cameras.)

Objective. You will take the materials given and correctly complete the following:

(1) Load exposed film into your camera.

(2) Tell the function of each camera part.

Materials

(1) Student-furnished camera

(2) Roll of black-and-white film for the student-furnished camera.

Procedures

(1) Have the instructor watch as you complete the activity.

(2) Open the camera back by pressing the button which releases it.

(3) Place the film in the camera.

a. Cartridge film is ready for use.

b. Film that has to have a leader (35 mm) must be threaded into film advance.

(4) Close the camera back.

(5) Explain the function of each camera part.

Vocabulary Worksheet

1. roll film

2. camel's hair brush

3. lens cleaner

4. lens cleaning tissue

5. interchangeable

6. sprockets

7. Instamatic

TEST

Unit 4: Handling the Camera

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. There is only one way to load film into your camera. This is—

A. in the darkroom
B. at night
C. as soon as you buy your film
D. the right way

___ 2. If the camera is to be stored, you should—

A. dust the camera
B. put film in the camera
C. remove the battery if the camera has one
D. all of the above

___ 3. Never carry a camera—

A. swinging from its strap
B. aimed at the subject
C. with the strap around your neck
D. with the strap over the shoulder and neck

___ 4. Lens cleaning includes the following, except—

A. lens cleaning tissue
B. camel's hair brush
C. lens cleaner
D. water

___ 5. Always try to load and unload your camera—

A. in direct sunlight
B. in a darkroom
C. in subdued light
D. indoors

___ 6. The basic rule in holding a camera is to—

A. hold the camera level
B. hold the camera steady
C. hold the camera with the right hand
D. hold the camera with your fingers

___ 7. For very long exposures, you must—

A. hold the camera with both hands
B. try using the cable release
C. find a fence to lean against
D. hold your breath for five minutes

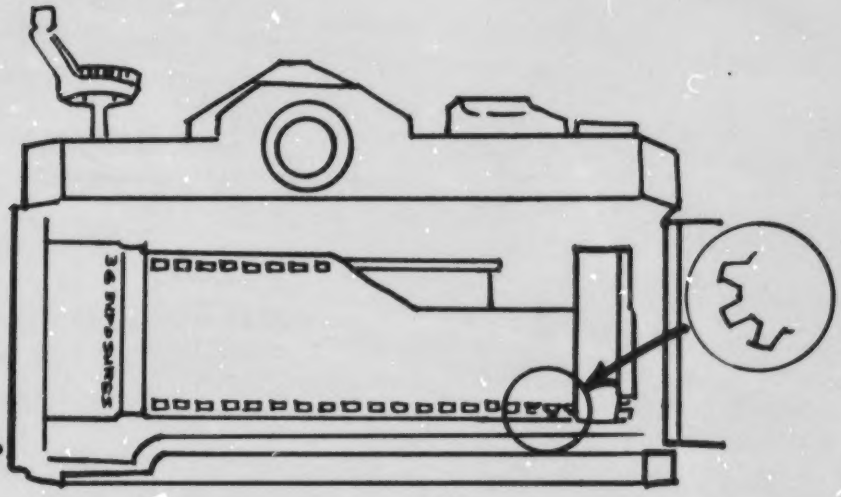
___ 8. The main thing to remember in changing lenses is that—

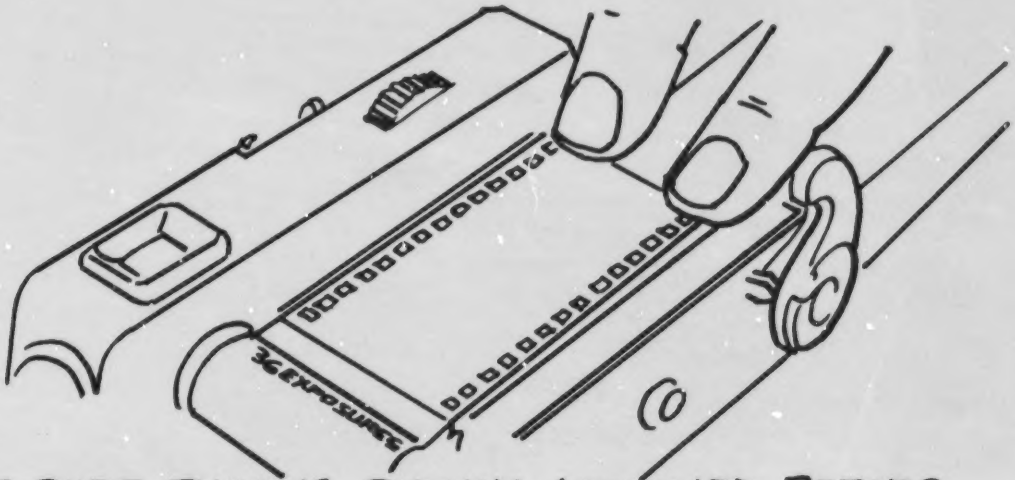
A. you must connect the correct end of the lens to the camera
B. you must have the correct f-stop setting
C. you must protect the interior of the camera body
D. there is no film in the camera

LOADING THE CAMERA

1. OPEN CAMERA BACK.

2. ALIGN FILM SPROCKETS TO GEAR TEETH.





3. MAKE SURE FILM IS FIRMLY ATTACHED BEFORE CLOSING CAMERA BACK.

CARRYING THE CAMERA

1. ALWAYS USE THE CAMERA STRAPS.

2. ALWAYS USE BOTH HANDS.

HOLDING THE CAMERA

NORMAL POSITION

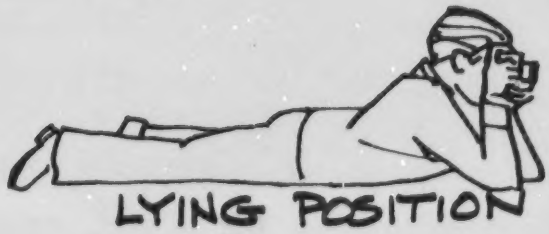
VERTICAL-IN (ELBOWS IN)

VERTICAL-OUT (ELBOWS OUT)

RESTING AGAINST PROP

HOLDING CAMERA AGAINST PROP

KNEELING POSITION



LYING POSITION

5 Composition

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. define composition;
2. list the principles of composition;
3. analyze a given photograph and indicate the compositional factors that are used; and
4. demonstrate good composition in a picture-taking assignment.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying photography. Teachers should help students understand these words as they are used in this topic of study.

composition	rule of thirds
simplicity	tone
subject placement	lines
balance	perspective
techniques	

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A, B, and C.
- Test Key: 1-D, 2-A, 3-C, 4-D, 5-C, 6-D, 7-C, 8-D, 9-B, 10-A
- Examples of compositional guidelines/ prints

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

The Beginnings of Photographic Composition, Eastman Kodak Company. Rochester, N.Y., slide/tape, 20 minutes.

Feininger, Andreas. Principles of Composition in Photography. Garden City, N.Y.: Amphoto, 1973.

Muse, Ken. Photo One. Englewood Cliffs, N.J.: Prentice-Hall, 1976.

Muse, Ken. Photo Two. Englewood Cliffs, N.J.: Prentice-Hall, 1977.

Photo Explorations. Eastman Kodak Company, Rochester, N.Y., ST-16.

Photographing People. Eastman Kodak Company, Rochester, N.Y., slide/tape, 17 minutes.

Photo Reports Make It Happen. Eastman Kodak Company, Rochester, N.Y., slide/ tape, 11 minutes.

Photos Help You When Disaster Strikes. Eastman Kodak Company, Rochester, N.Y., slide/tape, 10 minutes.

Teacher's Guide to Composition. Eastman Kodak Company, Rochester, N.Y., AT-19.

SENTENCE OUTLINE

I. Introduction
Photography is communication. Composition helps a photographer to communicate a fact, a story, a mood, an emotion, a relationship, or some insight that unveils the significance in the scene. We want the viewer of our photographs to see, understand, and be affected by what we saw in reality. We want this to happen instantly, without any ambiguity.

II. Instructional topics
A. Define composition
Composition is the use of the design principles and elements in such a manner as to create a pleasing arrangement of subject matter in the picture area.
B. Principles of composition
1. **Simplicity**
The key to producing good photographs is to keep the scene simple. Choose a subject that lends itself to a simple arrangement. To accomplish this, you need to move in on the scene and capture important features. The selection of different perspective positions and the use of different camera angles can help eliminate basic problems associated with the background and foreground. You must become aware of distractions in the foreground and background and also take advantage of any views that would add to the photograph.
2. **Subject placement**
The ideal location of the center of interest or **subject** in a compo-

sition is not the center of the picture. The method of locating the center of interest in the frame is referred to as the **Rule of Thirds.** According to this rule of composition, a subject is best placed in the lower or upper third of the frame, rather than centered in the frame.

3. **Balance**
   This compositional factor deals with the weighting and sizing of subjects in a scene to create a pleasing appearance.
   a. **Formal balance.** The idea of formal balance can be thought of as a seesaw with two objects of equal size and weight on opposite ends.
   b. **Informal balance.** When one object is larger or heavier than the other, the smaller will be kept in balance by placing the larger one close to the pivot point of the seesaw and the smaller one farther away from the pivot.
4. **Tone**
   The most intangible element of composition is tone. Tone may consist of actual shading from pure black to pure white, which is referred to as **chiaroscuro.** Tone may also consist of darks against lights with little or no shading, which is referred to as **notan.** The actual manipulation of lights against darks in varying degrees establishes the mood or tone of a composition.
   a. **High-key.** When a composition has tones that are mostly light, the picture is said to be a high-key print that conveys lightness, joy, and airiness.
   b. **Low-key.** If a composition has mostly dark shades, it is said to be a low-key print that conveys mystery, intrigue, and sadness.
5. **Lines**
   In composition, four basic line forms can be used to create certain effects. Lines refer to the makeup of the subject and scene and how the scene is laid out. The four line forms used in photography are:
   a. **Horizontal.** Horizontal lines represent peace, quietude, or tranquility. Pictures of landscapes consist of mainly horizontal lines and are, therefore, best suited to a horizontal printing format.
   b. **Vertical.** Vertical lines represent strength, rigidity, power, or solidarity. Pictures of buildings, massive machinery, and other objects of predominantly vertical line forms should be printed in vertical format to follow the line of vertical composition.
   c. **Diagonal.** The diagonal line is said to represent action, speed, and movement in a photograph. A photograph with many diagonal lines will represent a feeling of action, even though the subject may be static in nature.
   d. **S-curve.** The S-curve is sometimes referred to as the "Hogarth Line of Beauty." The modern design in architecture, free forms in art, and new designs in automobile bodies provide many interesting S-curves.
6. **Perspective techniques**
   Perspective refers to the illusion of the third dimension that is very desirable in photography. By using perspective techniques, the problem of depth can be solved with printing on a flat sheet of print paper.
   a. **Diagonal line use.** Use lines that stay within the picture. Avoid diagonal lines that run out of one of the four sides of the print.
   b. **Framing techniques.** Framing has to do with the placement or selection of an object that tends to actually put a frame on the subject on one side or all sides. By placing objects in the foreground to create a frame, one can create a feeling of depth. Framing objects

can consist of trees, rocks, figures, and buildings.

c. **Use of light and dark tones.** By the use of the "chiaroscuro effect," the playing of light and dark tones with one another can create a feeling of depth and perspective in a scene.

d. **Leading lines.** These are lines that catch your eye as you look at a photograph. They are used to provide direction or to draw focus to a point of interest. Examples of leading lines are a fence, a road, a river, or any line that leads to or indicates a point of interest.

7. Other compositional factors

a. **Horizon treatment.** The horizon lines should never be placed in the center of a composition. The rule to follow is to provide one-third of the design space for the horizon if it is simple and not of interest. If the horizon is of interest, provide two-thirds for the horizon and one-third for the sky area.

b. **Sky area.** The treatment of the sky area is very important. Be sure to avoid a bald sky, or a pure white space, in the sky portion of the print. To correct this, you can burn in the sky or print down the sky area by exposing it twice as long as the foreground. Also, a cloud negative could be used to print in the bald sky. Then print the regular negative.

c. **Color merger.** Poor color separation between the subject and the background can present difficulty to a photographer. Many subjects within nature blend into their environment. A keen eye and attention to the angle of the camera will prevent color merger.

d. **Subject-eye placement.** Eye placement refers to the direction in which the subject is looking. The subject should not look out of the scene area. Do not let the subject look directly at the camera lens. The line of sight should be off to one side of the camera position. When a person is used to provide framing in the foreground, they should look into the scene.

e. **Story-telling pictures.** The key to story-telling pictures is to move in close and capture the activity so that it is very clear and sharp. Concentrate on one, and only one, center of interest. Be aware of distracting backgrounds, such as fences, cars, telephone poles, trees, and other obstacles that appear to grow out of the subject. A good hint is to look way beyond the subject and well in front for distractions. Make use of framing items. Remember, if an unwanted background is unremovable, use a different camera angle and/or a large aperture to block out the background.

MATERIALS FOR STUDENTS

(Listed with activities)

SUGGESTED STUDENT ACTIVITIES

1. **Picture taking and Lab Task Assignment I** (subjects, your choice).
   a. Compose one picture to illustrate the proper use of each of the following principles of composition: simplicity, subject placement, balance, tone, distance (subject size), and camera position.
   b. Develop your film based on lab procedure to obtain a high-contrast negative.
   c. Make one (3" x 5") print of each negative, and be aware of your composition at the enlarger.
2. Have students select examples of good composition and bad composition from magazines, newspapers, and so forth.

Optional Activity

3. **Picture taking and Lab Task Assignment II** (subjects, your choice).

a. Expose one or more rolls of film using as many of the compositional factors as possible in each exposure.
b. Divide the roll or rolls of film into four equal parts (with three negatives of each subject). Expose the three negatives on each subject by concentrating on the total compositional makeup of that scene. Make sure you do not expose the three frames from the same position, angle, or perspective. Move around the scene to obtain three excellent exposures with high compositional quality.
c. Develop your film.
d. Make one (4" x 5") print of each subject that displays the highest compositional quality. Be aware of your composition at the enlarger.
e. Make one (5" x 7") print of the negative in this unit that is superior in all aspects of composition. Be aware of composition at the enlarger.
f. Make one (8" x 10") print of the same negative used in step "e". Again, be aware of composition at the enlarger.

Vocabulary Worksheet

1. composition

2. simplicity

3. subject placement

4. balance

5. rule of thirds

6. tone

7. lines

8. perspective techniques

TEST

Unit 5: Composition

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Simplicity refers to the—

A. overall scene
B. subject
C. simple arrangement
D. all of the above

___ 2. The rule of thirds refers to the—

A. placement of the subject in the frame
B. use of three subjects
C. distance of a minimum of three feet
D. none of the above

___ 3. Balance refers to the—

A. equal use of foreground with background
B. subject being centered in the frame
C. weighting and sizing of the subject in a scene
D. proper use of all ranges of color

___ 4. Tone refers to the—

A. use of all ranges of a color
B. use of backlighting
C. use of high keys and low keys
D. use of shades from pure black to pure white

___ 5. Lines refers to the—

A. guidelines in your picture frame
B. use of individual lines to divide the picture
C. makeup of the subject or scene and how the scene is laid out
D. a series of lines used to divide the picture

___ 6. Perspective techniques refers to the—

A. use of diagonal lines
B. framing techniques
C. leading lines
D. all of the above

___ 7. Composition is defined as the use of design principles to—

A. properly expose the film
B. properly arrange the "f" stop setting
C. create a pleasing arrangement of subject matter
D. create a setting for the picture area

___ 8. The key to producing good photographs is—

A. to have the subjects dress in white
B. to include background and foreground in the scene
C. to use new film
D. to keep the scene simple

___ 9. In composition, the four basic line forms are—

A. angle, right, left, and straight
B. horizontal, vertical, diagonal, and S-curve
C. obtuse, oblique, triangular, and geometric
D. leading, following, ruling, and tonal

___ 10. In picture composing, story-telling pictures should be—

A. close, clear, and sharp
B. merged
C. framed
D. light- and dark-toned subjects

6 Exposure

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. explain the term exposure;
2. identify two exposure controls found on most adjustable cameras;
3. use information on how a shutter works;
4. explain the f-stop system; and
5. successfully expose a roll of film.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying photography. Teachers should help students understand these words as they are used in this topic of study.

exposure	shutter speed
shutter	f-stop system
leaf shutter	depth of field
focal plane shutter	iris shutter

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A, B, and C.
- Test Key: 1-D, 2-A, 3-D, 4-B, 5-B, 6-A, 7-B
- Examples of shutters (leaf (iris) and focal plane)
- Transparencies: You will find transparencies P6-1 through P6-3 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  P6-1: Shutter Types
  P6-2: F-stop System
  P6-3: Depth of Field

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Blaker, Alfred A. Photography: Art and Technique. San Francisco: W. H. Freeman & Company, 1980.

Davis, Phil. Photography. Dubuque, Iowa: William C. Brown Company, 1979.

Dunn, J. F., and Wakefield, G. L. Exposure Manual. Dobbs Ferry, N.Y.: Morgan and Morgan, 1974.

Swedlund, Charles. Photography. New York: Holt, Rinehart and Winston, 1974.

SENTENCE OUTLINE

I. Introduction
To many people, the act of exposing film is merely the adjustment of a series of controls that will cause a meter needle to align with a mark. The material in this unit is designed to express the basis of relationships that exist between shutter speeds and apertures, as well as their role in exposure.

II. Definition of exposure
A. **Exposure** could be defined as the effect of a specified quantity of light (controlled by the diaphragm) striking the film for a specified length of time (controlled by the shutter).

B. **The shutter** (Transparency P6-1)

1. **The leaf shutter** (or **iris shutter**)
The most commonly used shutter type consists of from three to five thin metal or vulcanite blades, opening and closing across the light path like the leaves of a lens diaphragm. Since the shutter opens outward from the lens axis as a growing star-shaped aperture, the image is affected evenly. Each shutter blade is pivoted at its outer edge and linked to a ring that is rotated to open the blades. Power for this rotation comes from a main driving spring which, on precision shutters, must first be set. Such a tensioning system enables a more powerful and reliable spring to be used.

Nearly all modern diaphragm shutters contain internal electrical contacts that close at the appropriate part of the exposure cycle to fire the flash unit.

2. **The focal plane shutter**
Opaque fabric or slotted metal blinds on spring-loaded rollers can

be used as shutters at the back of the camera, just in front of the film. The blind contains a slit which passes across the face of the film and creates the exposure. Exposure duration is controlled by adjustment of slit width, or blind speed, or both together.

More often, the shutter consists of two blinds, one following the other after a predetermined gap. With either system, arrangements are made for the slit to be covered or closed when being moved across the film into the tensioned position prior to exposure. Most focal plane shutters fitted to **small-format cameras** have a constant tension spring and, therefore, a fixed blind speed. Only the slit width is adjustable by the exposure control knob.

C. **Shutter speeds**

The standard sequence of shutter speeds now offered by most shutters is B (bulb), 1, 1/2, 1/4, 1/8, 1/16, 1/30, 1/60, 1/125, 1/250, 1/500, and 1/1,000 second. Very few leaf shutters have faster speeds than 1/500 second. Some focal plane shutters are as fast as 1/2,000 second.

III. **The f-stop system** (Trans. P6-2)

A. The sixth letter of the alphabet is the most frequently used symbol in photography. It is an abbreviation for the term "factor" and symbolizes the relationship between the diameter of the lens opening and the focal length of the lens.

B. The size of the aperture, or lens opening, is controlled by a diaphragm, or stop.

C. In its simplest form, a diaphragm is a metal plate with a hole in it that limits the amount of light that passes through the lens.

D. In better cameras, it is usually an iris diaphragm, patterned after the iris of the eye.

E. The number after the letter f, then, indicates the relationship between the aperture and the focal length of the lens.

F. Thus, if it is marked f/8, it means that the opening in the stop has a diameter equal to 1/8 of the focal length of the lens.

G. This simple and accurate method for predetermining the changes in light intensity due to aperture changes was conceived by some members of the Royal Photographic Society of Great Britain in 1881.

H. They adopted a sequence of aperture ratios that gave each successive stop an **area** just half as large as the one that preceded it.

I. Each numerical stop, therefore, lets through twice as much light as the next higher numbered stop. For example, a stop marked f/11 allows twice as much light to pass as a stop marked f/16.

J. The reason a multiple of "2" was selected is that light intensity must be doubled or halved before the eye will detect a change in intensity.

K. The higher the number following the f, the smaller the opening, and the smaller the number, the larger the opening.

L. The following series shows the chief sizes of stops used in the international f-stop system today.

f-stops: f = 1.4 2 2.8 4 5.6 8 11 16 22 32 45

M. These really represent a diameter that is a fractional part of the lens' focal length

$$\frac{1}{1.4} \quad \frac{1}{2} \quad \frac{1}{2.8} \quad \frac{1}{4} \quad \frac{1}{5.6} \quad \frac{1}{8}$$

$$\frac{1}{11} \quad \frac{1}{16} \quad \frac{1}{22} \quad \frac{1}{32} \quad \frac{1}{45}$$

and the exposure ratios called for by these stops.

$$\frac{1}{8} \quad \frac{1}{4} \quad \frac{1}{2} \quad 1 \quad 2 \quad 4$$

8 16 32 64 128

N. This means that it takes 128 times as long to make an exposure at f/45 as it does at f/4 under the same lighting conditions.

IV. **Exposure formula**

A. It has been stated that exposure is the combined effect of controlling the light intensity (aperture) and the time

the light is allowed to strike the film (shutter).

B. From this, we may say that exposure is I x T or IT:

Exposure = Intensity x Time

C. Exposure is the combined effect of aperture size and shutter speed: f/8 at 1/60 second, f/16 at 1/500 second, and so on.

D. From the f-stop relationships and shutter speed relationships, it could be said that all the following exposures are equal:

f/11 at 1/125 second
f/8 at 1/250 second
f/5.6 at 1/500 second

E. An important concept that students often have trouble with is the idea that an aperture of f/8 on one lens allows the same quantity of light to reach the film as an aperture of f/8 on any other lens.

F. This means that f/8 on a 50 mm lens allows the same amount of light to pass through the lens as an aperture of f/8 on a 500 mm lens.

G. Since all the above exposures are equal, a common question is, "How do you know which combination of shutter speed and aperture to use?"

H. The answer to this question depends on the desired depth of field.

V. **Depth of field** (Trans. P6-3)

A. When a lens is critically focused on a specific subject, objects closer to the camera or farther away from it will be rendered more or less unsharp. This increases the farther they are from the actual plane of focus.

B. This zone of apparent sharpness is called the depth of field.

C. The extent of the depth of field varies with three factors:

1. distance between subject and camera
2. focal length of the camera
3. diaphragm aperture selected

D. Depth of field will be more extensive, with a greater camera-to-subject distance, a shorter focal length, and a smaller aperture.

SUGGESTED STUDENT ACTIVITIES

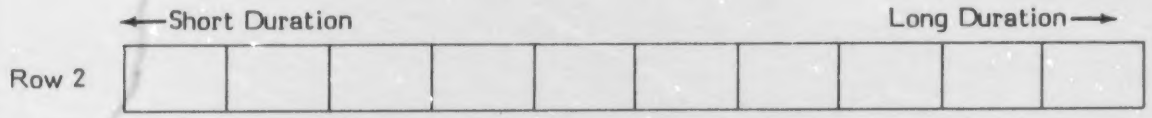
1. Exposure

Instructions to the student: Following is a list of f-stops and a list of shutter speeds. Proceed with these steps:

A. Arrange the f-stops into row one of Table 1, ordered such that the f-stop representing the largest lens opening is on the left and the f-stop representing the smallest lens opening is on the right.
B. Arrange the shutter speeds into row two of Table 1 such that the fastest shutter speed is on the left and the slowest shutter speed is on the right.

TABLE 1

F-Stops					Shutter Speeds				
16	1/4	8	5.6	11	1	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{1}{30}$	$\frac{1}{250}$
22	2	4	2/8	32	$\frac{1}{125}$	$\frac{1}{4}$	$\frac{1}{15}$	$\frac{1}{60}$	$\frac{1}{500}$



C. From the list of apertures and shutter speeds given in Table 1, complete the chart shown in Table 2 such that each exposure combination is equal to f/5.6 at 1/30 second.

TABLE 2

	Aperture	Shutter Speed
1.	8	
2.		1/500
3.		1/4
4.	2	
5.	5.6	1/30
6.	11	
7.		1
8.	2.8	
9.		1/60
10.	22	

2. Exposure Meter Readings

Using the given time in seconds, read the exposure meter and give the f-stop for that given time. You are to hold the exposure meter, if available, at a distance of 12" to 18" from the subject and make a reading of each subject listed. Or you may use the meter in your camera.

TABLE 3

	1/30	1/60	1/125	1/250	1/500
Tree					
Car					
Person in semishade					
Person in full shade					
Person in full light					
Shaded wall					
Person beside a tree trunk					

Note: Each student must do this independently so that he or she will know how to properly read the exposure meter and transfer these readings to the camera.

Vocabulary Worksheet

1. exposure

2. shutter

3. leaf shutter

4. focal plane shutter

5. iris shutter

6. shutter speed

7. f-stop system

8. depth of field

TEST

Unit 6: Exposure

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: C 21. The class you are now attending is—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Exposure can be defined as—

A. the effect of a specified quantity of light
B. light striking the film for a specified length of time
C. a tensioning system
D. A and B

___ 2. The two types of shutters are—

A. the leaf and focal plane
B. the bayonet and screw-on
C. the aperture and exposure
D. the hyperfocal and normal

___ 3. Typical shutter speeds are—

A. B, 1, 1/10
B. B, 1, 1/15
C. B, 1, 1/25
D. B, 1, 1/30

___ 4. The "f" in the term f-stop system refers to—

A. focal
B. factor
C. filament
D. fractional

___ 5. The higher the number following the "f" in f-stop—

A. the larger the opening
B. the smaller the opening
C. the opening is one-half
D. the opening is twice as large

___ 6. Exposure equals—

A. intensity x time
B. aperture x time
C. intensity x aperture
D. depth of field x time

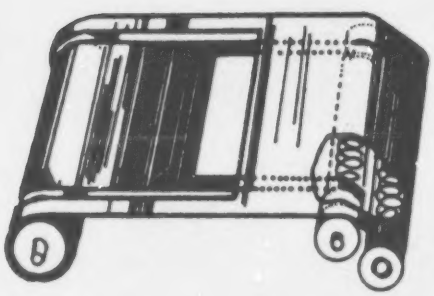
___ 7. Depth of field is—

A. the extent that a lens can focus
B. the zone of apparent sharpness
C. the infinity setting on a camera
D. full aperture metering

SHUTTER TYPES

Leaf shutter

Focal plane shutter



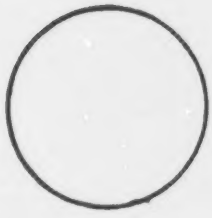
F-STOP SYSTEM

LENS OPENING SIZES

f-STOP OPENINGS

f/1.4

f/22



f/2.8

f/16

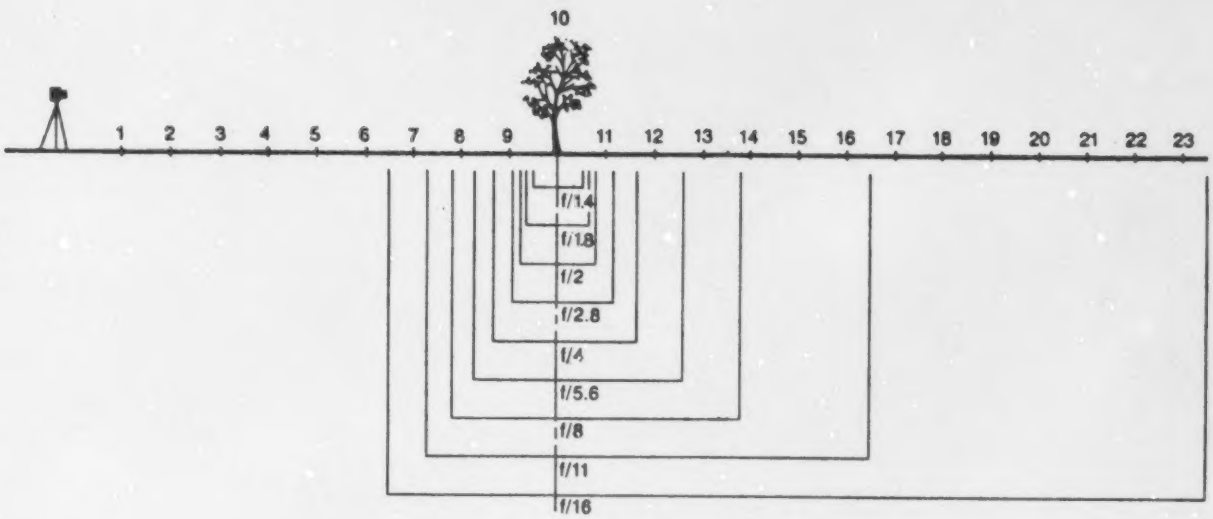
f/4

f/11

f/5.6

f/8

DEPTH OF FIELD



DEPTH OF FIELD
FOR 50 MM LENS
FOCUSED AT 10 FEET

7 Film and Film Development

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. explain the structure of black-and-white film;
2. describe the various characteristics of black-and-white film;
3. identify the various types of black-and-white film;
4. explain the steps in developing black-and-white film by the tank method;
5. properly develop exposed film; and
6. properly handle and store negatives.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying photography. Teachers should help students understand these words as they are used in this topic of study.

film layers	tank method
color sensitivity	tray method
speed (ASA/ISO)	developer
grain	stop bath
contrast	fixer
orthochromatic film	measuring graduate
panchromatic film	

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A, B, and C.
- Test Key: 1-D, 2-D, 3-B, 4-A, 5-A, 6-B, 7-A, 8-B, 9-D, 10-B, 11-B, 12-D
- Transparencies: You will find transparencies G7-1 and G7-2 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  P7-1: Film and Its Parts
  P7-2: Film Development Equipment

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from the Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Black-and-White Darkroom Techniques. Eastman Kodak Company, Rochester, N.Y., 1981.

Developing Roll Film. Creative Photography Darkroom Series, Arizona State University, filmstrip/tape.

Film: How It Works. Eastman Kodak Company, Rochester, N.Y., 18 1/2 minutes, slide/tape.

The Film/Paper Story. Eastman Kodak Company., Rochester, N.Y., 19 minutes, 16 mm.

Kodak Darkroom Dataguide. Eastman Kodak Company, Rochester, N.Y., 1982.

Langford, M. D. Basic Photography. Garden City, N.J.: Amphoto, 1974.

Muse, Ken. Photo One: Basic Photo Text. Englewood Cliffs, N.J.: Prentice-Hall, 1978.

Processing Black-and-White Film. Eastman Kodak Company, Rochester, N.Y., 19 minutes, slide/tape.

SENTENCE OUTLINE

I. Film (Transparency P7-1)
   A. Photographic film is a relatively recent invention in the history of photography. For many years prior to the introduction of film in 1887, glass plates were used instead. In fact, many scientists and technicians today still use photographic glass plates for special purposes. The photographic films available today are the result of much research and are very different from the earlier types. Every roll of film has at least five **film layers.**
      1. The first layer is known as the topcoat. It is a protective layer of hard gelatin that helps protect the emulsion from scratches and other foreign substances.
      2. The second layer, the emulsion, usually contains light-sensitive silver bromide and silver iodide. These light-sensitive particles in the emulsion layer are made more so by the addition of certain sensitizing agents. Upon exposure to light and chemical development, the silver is reduced to fine particles of silver metal that look black.

3. The third layer, the subbing, is a gluelike substance that holds the emulsion layer to the base. In the past, many unusual materials were used for this purpose. One of the most popular subbing materials was egg white (albumen).
4. The fourth layer, the support or base of the film, is generally a plastic. It is usually a cellulose acetate. Its purpose is to provide a transparent and flexible foundation for the emulsion. At one time, the support was made out of nitrocellulose, a highly flammable early plastic. The common use of nitrocellulose in early motion-picture films resulted in frequent fires.
5. The fifth and last layer is the antihalation backing. The purpose of this layer is to prevent light from reflecting off the support layer or the back of the camera itself during exposure. If these reflections were not eliminated, light areas on the film would have halos around them that would reduce the sharpness of the image. The antihalation layer appears as the bluish or grayish color on one side of the film. Both the antihalation backing and the topcoat layers are dissolved away during processing.

B. Characteristics
1. Film has four characteristics: (a) **color sensitivity,** (b) **speed** (ASA/ISO), (c) **grain,** and (d) **contrast.** Black-and-white emulsions are classified into three groups in their ability to differentiate between colors. These are blue-sensitive, orthochromatic, and panchromatic. Blue-sensitive film uses the pure state of the silver bromide, which makes the emulsion sensitive to light. This film is sensitive to blue and ultraviolet light. It is high in contrast, which makes it useful for copying manuscripts, drawings, and other materials that do not have a long tonal range.
2. **Orthochromatic film** is sensitive to green light, as well as to blue and ultraviolet light. However, orthochromatic film is not sensitive to red. If a red object such as a fire hydrant were shot with orthochromatic film, it would appear as a black tone in the photo. Because ortho emulsions are not sensitive to red, they can be handled in red safelight illumination. Most black-and-white photographic papers are orthochromatic.
3. **Panchromatic film** is sensitive to all the colors of the spectrum. Because of this quality, it gives the most natural-looking interpretation of color in terms of the black-and-white tonal scale. In almost all cases, the films that you have been using are probably panchromatic. To summarize, panchromatic films are sensitive to all colors, orthochromatic films are sensitive to all but red, and blue-sensitive films are sensitive to only blue and violet light (plus radiation).
4. Speed, the second characteristic of film, is the sensitivity of film to light. Speed is measured on a scale set by the International Standards Organization, referred to as the "ISO." In addition, the initials of the American Standards Association, "ASA," are used. Film speed is referred to as the "ASA/ISO" number. The higher the film speed, or ASA/ISO number, the less sensitive the film is to light. For example, the ASA/ISO of Kodak's Tri-X is 400. The ASA/ISO of another Kodak film, Plus-X, is 125. Therefore, Tri-X is "faster" than Plus-X, which means it requires less light for exposure. The faster the film, the less light needed for exposure.
5. There is a definite correlation between the ASA/ISO rating numbers. Suppose we start with a base ASA/ISO of 25. ASA/ISO 50 would be twice as fast as ASA/ISO 25. ASA/ISO 100 would be twice as fast as 50 and four times as fast as ASA/ISO 25. This

is the same type of correlation that exists between shutter speeds and f-stops. For example, given a certain lighting situation, let us presume that using an ASA/ISO film at f/5.6 with a shutter speed of 1/125 will produce a correct exposure. If an ASA/ISO of 100 instead of 50 is used, the correct exposure is f/8 at 1/125 or f/5.6 at 1/250. In the case of the f-stop, you have to decrease the amount of light by one stop (half the amount of light) in order to get a correct exposure when the ASA/ISO is doubled. This in turn will increase the depth of field. In the case of the shutter speed, we have increased it by one speed. This means that we are allowing half as much light to pass through the lens. The result of this is that the subject will be frozen in action. Whenever a smaller lens opening is preferred for more depth of field, or a quicker shutter speed is desired to freeze action, a higher ASA/ISO film should be used.

6. Grain, the third characteristic of film, refers to the bunching or clumping of the reduced silver portions in the emulsion during development. Grain exists in all photographs. A "grainy" print is one in which the clumping of the silver particles is very noticeable. However, certain rules can be followed to control graininess. First, the higher the ASA/ISO of the film, the grainier it is. When image smoothness is essential, use a slower (lower ASA/ISO) film. Second, overexposure and overdevelopment contribute to graininess. Third, enlarging an image to a high magnification will cause grain to be seen more readily. This is why cropping is not recommended.

   A 5" x 7" print made from a 35 mm negative looks very good. However, if that same negative were enlarged to the 16" x 20" size, it might look like sandpaper. Fourth, graininess is also controlled by the type of film developer used. Some developers are made to be used with fine-grain films, while others produce a very harsh grain.

7. The fourth characteristic of film is contrast. This is the ability of the film to distinguish between the tones or values of gray. Some films are high in contrast and are used only to copy line drawings or manuscripts. Most films that you will be using can reproduce a wide tonal range.

8. Film also has other characteristics, such as latitude, acutance, and resolving power. The science of sensitometry is related to the study of film characteristics. If you are interested in the field, many technical reference books on the subject are available.

C. Brand of films

There are many different film manufacturers, both in the United States and abroad. Because film is constantly being improved and changed, it is wise to check the information sheet packed with each individual roll to obtain the newest data about a film. The following is a list of the most popular black-and-white films manufactured by Eastman Kodak, along with descriptions of their characteristics.

1. Panatomic-X (ASA/ISO 32). Panatomic can reproduce the greatest amount of detail and has the finest grain of any of the films listed here. However, it has a slow ASA/ISO, which limits its use in dim light.
2. Verichrome Pan (ASA/ISO 125). Verichrome is a medium-speed film that is normally used in non-adjustable cameras. It has a medium-fine grain.
3. Plus-X (ASA/ISO 125). This is a medium-fine grain film with a speed that is adequate for most picture-taking situations. Plus-X is the conventional, all-purpose panchromatic film.
4. Tri-X (ASA/ISO 400). This is a very fast film, and so it is useful for picture taking in existing in-

door light. It is also useful when depth of field and/or faster shutter speeds are needed. Tri-X, because of its high ASA/ISO, does not have as fine a grain as the other films in this listing.

II. Basic film development

A. After you have taken a picture, curiosity alone will make you want to see it, even if you suspect it is overexposed, underexposed, or out of focus. Developing the film is the halfway point between taking the picture and printing the negative. It makes visible and permanent the latent image that is recorded on the film emulsion. Film development is a chemical process that involves a very definite series of steps. If the exposure is correct, this procedure, followed carefully, will produce a good-quality negative. That negative, in turn, will determine the quality of the resulting print.

Almost all films are sensitive to every color of light. Thus, film developing must be done in total darkness. Ironically, the same light needed to take the picture will ruin it when the film is unloaded from its lighttight packaging.

There are two basic methods of film development. In one, open trays of chemicals are used; in the other, a closed tank. The tank method is the more efficient and does not require total darkness after the film is loaded into the developing tank. It gives you a better chance of getting a good-quality negative. The **tray method** is seldom used for developing roll film because all the steps must be carried out in complete darkness. However, it is useful when developing cut film (sheet film).

B. **The tank method**

The basic developing tank consists of the tank itself, the lid (to make it lighttight), and the reel (to hold the film). Tanks are made of either plastic or stainless steel, and many different brands are available.

Plastic developing tanks usually are cheaper than stainless steel tanks. Most of them have reels that adjust to accommodate film sizes from 35 mm up to 120 film. To load the plastic tank, first adjust the reel to the size of the film. For Instamatic-type cartridges or 35 mm, the flange of the adjustable reel should be moved down as far as it will go. For 127 film, the reel is locked into the second notch. When using 120 or 620 film, spread the reel out as far as possible until it locks into position.

The next steps must be carried out in total darkness. Make sure the reel is clean and dry before attempting to load the film into it. To load 35 mm film, first remove the cartridge that encloses the film. Use a bottle opener to carefully remove the flat flange on the top of the cartridge. Take the spool of film from the cartridge, but leave the film on the spool. (Keep the film perpendicular, rather than letting it swing back and forth like a pendulum). With scissors, cut off the tapered beginning of the film (the leader).

With roll film (sizes 828, 127, 620, 120), you need only to break the seal to load it. The film curls as it is separated from the paper backing, and it should be handled only by the edges to prevent getting fingerprints on the emulsion. The film is attached to the paper with tape, which must be removed before the film is loaded into the reel. Otherwise, it will prevent proper loading.

If 126 film (Instamatic-type) is used, remove the film by gripping the cartridge with both hands and twisting it until it breaks in half. The film is in the larger of the two chambers. After that chamber is broken as well, separate the film from the paper backing in the same manner as with the roll film.

After the film has been removed from its container, insert the film into the reel by pushing it carefully through the entrance slots (the thickest part of the flanges). As you do this, follow the natural curl of the film so that emulsion side will face toward the core of the reel. It is less likely to be scratched and will be easier to load this way. Take hold of the edges of the reel.

Continue this procedure until the

film is wound onto the reel. If you are loading 35 mm film, this action will stop when the spool reaches the entrance. Cut the film at the edge of the spool and continue winding it onto the reel. You can make sure that all the film is wound onto the reel by running your finger around the entrance slots. The edge of the film should be past the entrance.

If the film does not go onto the reel smoothly, do not force it, or you may mar the film permanently. Do not try to pull the film back through the entrance. Instead, pull off the adjustable flange, remove the film, readjust the reel to the film size, and start again. After all the film is on the reel, place it in the tank, and place the lid on the tank. The room light may now be turned on since the tank is lighttight.

III. Development process and equipment

A. The development process

1. The first bath of the development process is the **developer**, a mixture of several chemicals balanced to work at a specified temperature.
2. Usually, this is 68°F (20°C).
3. The developing solution will affect both unexposed and exposed silver halides.
4. Exposure increases the rate by which silver halides can be converted by the developing solution into black metallic silver, so the exposed image develops first.
5. However, prolonged development attacks unexposed grains. Any increase over manufacturers' recommended times is inclined to give the film an additional overall gray tone, known as chemical fog.
6. The second stage is the **stop bath.**
7. At the end of the developing time, pour the developer out of the developing tank and replace it with the stop bath. This is a mildly acidic solution that halts the action of the alkaline developer.
8. This ensures that the degree of development is accurate and prevents alkaline carry-over into the third bath which contains fixer, an acid solution.
9. The developer and stop bath leave the film light-sensitive and opaque, but with a visible black negative image.
10. The final chemical, **fixer**, makes the remaining light-sensitive salts on the film soluble so that they can be removed by washing in running water, usually for 30 minutes. (This can be shortened by the use of a clearing agent.)
11. Excess water is removed from the processed film and it is then hung up to dry in a dust-free area. An additional drying and hardening agent may also be applied, called "Photo-Flo."
12. Finally, the dry negatives are cut into strips and filed into protective envelopes (see Table 1).

B. Developing equipment (Trans. P7-2)

1. A full outfit of developing equipment is advisable. This ensures absolute accuracy when developing films.
2. Timing and temperature must be carefully controlled. Therefore, a timer and thermometer are of primary importance.
3. The daylight developing tank, one loaded in darkness, can be used in normal light.
4. Once prepared, bottles of chemicals should be kept at a constant temperature in a tray of water at 68°F (20°C).
5. Other useful items include a measuring graduate and a funnel for easy pouring of chemicals into tanks and bottles, a hose to connect the water source to the tank for washing, squeegee tongs, clips, sponge, and scissors.

TABLE 1

NEGATIVE CHARACTERISTICS: SOME PROBLEMS AND SOLUTIONS

	UNDEREXPOSED	NORMALLY EXPOSED	OVEREXPOSED
UNDERDEVELOPED	Overall appearance—almost transparent, density very low Contrasts—extremely low Shadow details—almost void Highlights—much too weak Remedy—print on extremely high-contrast paper (hard gradation) Results—very bad	Overall appearance—thin, density too low Contrasts—too low Shadow details—becoming visible Highlights—too weak Remedy—print on high-contrast paper Results—pretty good print	Overall appearance—density about normal Contrasts—too low Shadow details—too strong Highlights—not strong enough, a bit too dense Remedy—print on very high-contrast paper Results—pretty good print
NORMALLY DEVELOPED	Overall appearance—thin, density too low Contrasts—too much Shadow details—very faint Highlights—thin Remedy—print on high-contrast paper Results—bad	Overall Appearance—the "ideal," normal density Contrasts—normal Shadow details—present Highlights—strong, but still transparent Remedy—none needed, print on normal-contrast paper Results—good print	Overall appearance—density, too high Contrasts—too low Shadow details—too much Highlights—too dense, pronounced graininess Remedy—print on high-contrast paper Results—pretty good
OVERDEVELOPED	Overall appearance—density about normal Contrast—much too high Shadow details—faint Highlights—rather dense Remedy—print on very low-contrast paper (soft gradation) Results—grainy print, lacking in detail	Overall appearance—dense Contrast—higher than needed Shadow details—strong Highlights—very black and "blocked," graininess Remedy—print on low-contrast paper Results—fair print, but grainy	Overall appearance—extremely high density, almost black Contrasts—low to normal Shadow details—too much Highlights—black and detailless, much grain Remedy—print on very high-contrast paper Results—fair print, grainy and less sharp

MATERIALS FOR STUDENTS

The following list is representative. The materials and supplies you use will depend on local situations:

1. Processing tank and reel
2. Chemistry containers and mixers
3. Thermometers
4. Timers
5. Funnels
6. Measuring graduates
7. Time-temperature chart
8. Towels
9. Film drying cabinet
10. Film cleaner
11. Chemicals

SUGGESTED STUDENT ACTIVITIES

1. Students assist/participate in the mixing of the following chemicals: developer, stop bath, fixer, hypo clearing agent, and Photo-Flo.
2. Students demonstrate competencies needed in order to—
   a. load the film on a developing reel in total darkness or in a loading bag;
   b. measure the proper chemicals for development;
   c. develop a roll of black-and-white film; and
   d. place the film in the proper drying area.
3. Discuss the function of agitation in film development.
4. Properly interpret the steps in the development process. Explain what happens and why, either orally or in writing.
5. Discuss the various reasons or causes for negatives that are not properly developed.

Vocabulary Worksheet

1. film layers

2. color sensitivity

3. speed (ASA/ISO)

4. grain

5. contrast

6. orthochromatic film

7. panchromatic film

8. tank method

9. tray method

10. developer

11. stop bath

12. fixer

13. measuring graduate

TEST

UNIT 7: Film and Film Development

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: _C_ 21. The class you are now attending—

A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Photographic film has—

A. two layers
B. three layers
C. four layers
D. five layers

___ 2. The following are film characteristics, except—

A. speed
B. grain
C. contrast
D. texture

___ 3. Conventional film, such as Plus-X, is classified as—

A. orthochromatic film
B. panchromatic film
C. techchromatic film
D. trichromatic film

___ 4. The speed of film is measured by the—

A. ASA/ISO
B. SOS/ASA
C. ASA/OSO
D. SAS/ISO

___ 5. Film grain refers to—

A. the clumping of silver particles in the emulsion
B. the image of the film
C. the various layers
D. the substance from which film is made

___ 6. Film contrast is the ability of the film to—

A. distinguish between its layers
B. distinguish between tones of gray
C. distinguish between the silver and gold grains
D. distinguish between the speed of films

___ 7. A film that has a very fine grain is—

A. Panatomic-X
B. Verichrome Pan
C. Plus-X
D. Tri-X

___ 8. A film used mostly in nonadjustable cameras is—

A. Panatomic
B. Verichrome Pan
C. Plus-X
D. Tri-X

___ 9. A very fast film is—

A. Panatomic
B. Verichrome Pan
C. Plus-X
D. Tri-X

___ 10. There are ____ basic methods of developing film.

A. one
B. two
C. three
D. four

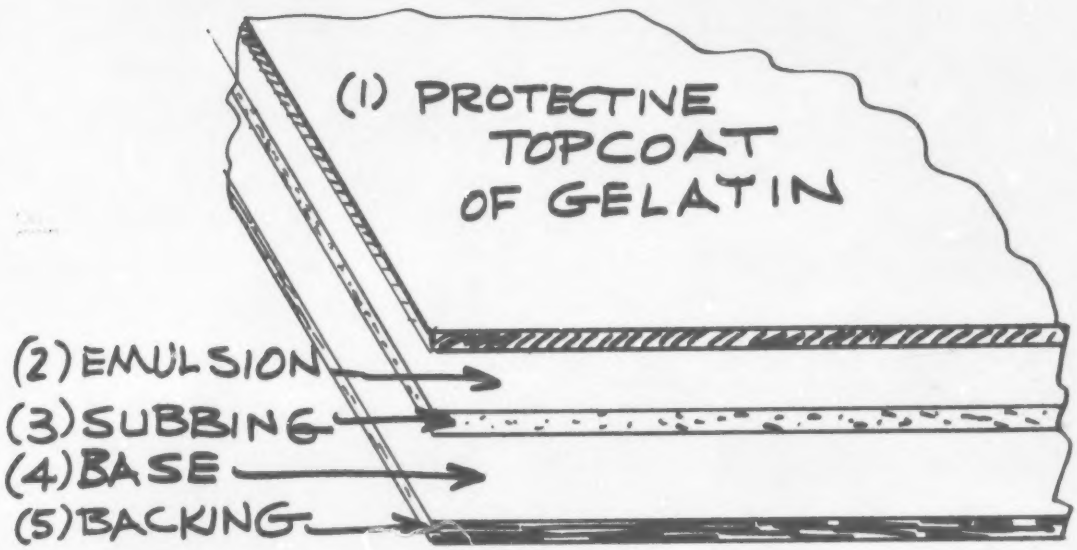
___ 11. Film development chemicals are to be used at a recommended temperature of—

A. $65^{o}F$
B $68^{o}F$
C. $72^{o}F$
D. $75^{o}F$

___ 12. The second stage in the development process is—

A. the fixer step
B. the washing step
C. the developing step
D. the stop bath step

FILM AND ITS PARTS



FILM DEVELOPMENT EQUIPMENT

8 Print Development

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. produce finished prints from negatives developed;
2. identify the proper exposure settings for making properly exposed enlargements;
3. describe "burning in," "dodging," "vignetting," and "cropping" techniques of enlarging;
4. produce contact prints; and
5. produce test strips.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying photography. Teachers should help students understand these words as they are used in this topic of study.

enlarger	resin-coated paper
test strip	fiber-based paper
contact prints	easel
agitation	cropping
dodging	timer
burning in	polycontrast (PC) filters
vignetting	negative carrier

TEACHING AIDS

- Overhead projector
- Pointer
- Also, see Appendices A, B, and C.
- Test Key: 1-C, 2-C, 3-D, 4-B, 5-B, 6-C, 7-B, 8-A, 9-A, 10-D, 11-B, 12-A, 13-A
- Transparencies: You will find transparencies P8-1 through P8-3 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

  P8-1: A Typical Enlarger
  P8-2: Contact Printing
  P8-3: Tray Development of Prints

SUGGESTED REFERENCES

The following references represent only a few of those available. Other sources of information can be obtained from Eastman Kodak Company, 343 State Street, Rochester, N.Y. 14650.

Advanced Black-and-White Printing. Eastman Kodak Company, Rochester, N.Y., slide/tape, 24 minutes.

Beginning Black-and-White Printing. Eastman Kodak Company, Rochester, N.Y., slide/tape, 18 1/2 minutes.

Color Printing from Color Negatives. Eastman Kodak Company, Rochester, N.Y., 20 1/2 minutes, slide/tape.

Enlarging and Making a Contact Sheet. Creative Photography Darkroom Series, Arizona State University, Tempe, Arizona, filmstrip/tape.

Hattersly, Ralph. Beginner's Guide to Darkroom Techniques. Garden City, N.Y., Doubleday, 1976.

Hattersly, Ralph. Photographic Printing. Englewood Cliffs, N.J.: Prentice-Hall, 1977.

SENTENCE OUTLINE

I. Basic enlarging (Transparency P8-1)
   A. In painting, the finished product is displayed, not the preliminary sketches. In silk-screen printmaking, the prints are framed and viewed, not the screens used to make them.
   B. It is also true in photographic printmaking that it is not the negative that is viewed, but the print.
   C. Light rays are focused on photographic paper by a lens attached to the **enlarger.**
   D. An enlarging **easel** holds the paper in place.
   E. The sole purpose of the enlarger is to increase the size of the negative image that is being projected.
   F. Thus, from a very small negative, prints can be made that measure 8" x 10", and even larger. The size of the projected image is controlled by the height of the enlarger above the paper.
   G. The greater the distance between the paper and the lens of the enlarger, the larger the magnification will be. This also increases exposure time.
   H. The size of the projected image is changed by raising and lowering the entire body of the enlarger on the

vertical column.

I. Then the image must be brought into fine focus by turning the focusing knob on the enlarger. Focusing will again alter the size of the image somewhat, so it may be necessary to raise or lower the enlarger and then focus the image again.

J. All enlargers have lenses. The size of the lens (focal length) depends on the size of the negative being enlarged.

K. Generally, the focal length of the lens on the enlarger will match the "normal" focal length on the camera for a particular size of film.

L. For instance, the normal-size focal length lens for a 35 mm camera is 50 mm. Thus, a 50 mm lens is used on the enlarger.

M. A normal lens for a 2 1/4" x 2 1/4" camera measures 75 to 85 mm; this lens size would also be used on the enlarger. If a 50 mm lens were used to enlarge a 2 1/4" x 2 1/4" negative, it might not cover the full area of the negative, cutting off the corners of the image.

N. On the other hand, if a 75 mm lens were used to enlarge a 35 mm negative, it would produce a smaller magnification than a 50 mm negative, assuming that the enlarger-to-paper distance is not changed.

O. The brightness of the image is controlled by the iris on the lens. The more the lens is "stopped down," the less light will pass through it. Brightness also decreased as the enlarger is raised to give greater magnification.

P. The photographic paper must be kept perfectly flat during the exposure, or else one area of the paper will be out of focus while the rest is in focus.

Q. Enlarging easels are designed to hold the photo paper completely flat during the exposure. Most easels are adjusted by moving the thin, metal strips to form a mask. They can be masked off for various standard paper sizes, such as 3 1/2" x 5", 5" x 7", 8" x 10", and 11" x 14". This technique is known as cropping the image area.

R. The printing paper is inserted from one end and slides along the guides of the easel until it is centered within the mask.

S. The emulsion side of the paper faces up toward the enlarger lens.

T. A special enlarger **timer** can be used to control the amount of exposure.

U. Most of the timers on the market have a range of from 1-60 seconds.

V. Usually, there is a manual light switch to turn the enlarger on for focusing.

W. Once the timer has been set for the period of exposure, a button is pushed to begin the timing.

X. The timer then automatically turns on the enlarger light, and turns it off when the exposure has been completed.

Y. Although it is not as accurate, a switch on the enlarger line also can be used to turn the enlarger on and off to control the exposure.

Z. In this case, you must use a wristwatch to check the exposure time.

II. Contact printing (Trans. P8-2)

A. A **contact print** is the same size as the negative. For 35 mm formats, for example, a contact print is usually used for reference when selecting pictures for enlargement.

B. This will save time in being selective and also will save on materials.

C. The simplest way to make a contact print is to use a light box as the source of light.

D. The negatives are laid on the light box and covered by photographic printing paper so that their emulsion sides are together.

E. A sheet of glass is laid on top of the paper to ensure close contact between the paper and negatives during exposure.

F. Contact prints are more commonly made by using a contact printing frame with an overhead light source, such as an enlarger.

G. Such frames are usually designed to be used with standard photographic paper sizes.

H. Photographic printing paper is slipped under a glass sheet and covered by the negatives so that their emulsion sides are together.

I. The glass top is clamped to the base for perfect contact between the negatives and the photographic paper sandwiched in between.

J. Exposure is made when light passes

through the glass and negatives to reach the printing paper.

III. Making a **test strip**

A. Although exposure meters for use with projection printing are available, using a test strip is still the only way to make a personal judgment on the exposure time needed to produce a good-quality print.

B. When using unusual techniques, such as making large or very high-quality prints, the test strip gives far more helpful information than the purely objective measurement provided by an exposure.

C. Unlike the exposure meter, which only indicates an estimation of exposure time, the test strip shows a section of the final print exposed for different lengths of time.

D. Since the same paper and chemicals are used for the test strip, the finished enlargement density, contrast, and image color can all be judged.

E. Initial experiments with your enlarger will give you some idea of the length of exposure necessary to print a particular negative on a specific grade of paper.

F. Once the negative and paper are positioned in the enlarger, the test print can be exposed in sections.

G. Bands are exposed, say, for multiples of 5 seconds (for example: 5, 10, 15, 20, and 25 seconds) to make five bands in all.

H. The width of each band needs to be large enough to make a visual judgment of the print quality. The test strip must be made across an area of the image that contains a varied range of tones.

I. The print, when processed, will show five bands of density.

J. One band will probably be correct, while the others will be too light or too dark.

K. If you judge that correct density lies between two bands, make an exposure for halfway between these two exposure times for the final print.

L. If the test has too much contrast or is too soft in appearance, a different grade can be selected for the final print.

M. As most paper grades vary slightly in speed, it is recommended to use the same type of paper that will be used for enlarging.

N. On examining your chosen negative, you may know from experience whether it will require a harder or softer grade than normal, or you may choose the popular polycontrast PC paper and use **polycontrast filters**.

O. For straightforward work, you can judge the right-density band while the test strip is still in the fixing bath.

P. This saves time, but it is more accurate to judge the test strip in daylight after fixation and a brief wash.

IV. Making a print (Trans. P8-3)

A. One of the most satisfying aspects of photography is the printing process.

B. However, it must be well organized since errors are difficult to correct once they are made.

C. Certain conditions are vital to producing successful photographic prints.

D. A darkroom, whether built for that purpose or converted from another room, is essential. This is because photographic paper should only be handled under red or orange safelights.

E. Working in safelight conditions is simple, once your eyes have adjusted to the dimness.

F. Electricity and water supplies are obviously necessary, although running water is not vital in the darkroom itself.

G. The solutions used to process the prints work best at 68°F (20°C).

H. If the same room temperatures can be maintained, this is ideal.

I. All liquids should be kept well away from the enlarger and unexposed printing paper.

J. Before beginning the printing process, make sure that all the equipment and chemicals, correctly diluted, are ready for every stage.

K. Once the first stage has begun, there can be no interruption.

L. Arrange the equipment so that it can be easily handled.

M. The normal procedure is to expose a sheet of photographic paper to a negative image projected by an enlarger.

N. As soon as it is immersed in a chemical bath, timing must begin.

O. The print is usually left in the first